

STATE OF OREGON - DLCD

Analysis of Shoreline Armoring & Erosion Policies

Along the Oregon Coast

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4/30/2015

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Executive Summary

The Oregon coast is a beautiful and dynamic environment that draws people to the area to live, recreate, work, and enjoy. However, the high energy wave and wind environment of the coast can create a challenging setting for development and human life. Strong winter storms and erosion have led to loss of beach and property in many areas. Various adaptation strategies have been employed or discussed for how to both protect property and the public beach, from shoreline armoring to managed retreat. These strategies can be controversial depending on the stakeholder group, but are important to explore collaboratively. The Oregon Coastal Management Program and the Oregon Parks and Recreation Department, in consultation with local and state partners, have created this document in order to analyze and integrate current public policy regarding coastal erosion and shoreline armoring with the latest relevant geospatial and natural science information (including predicted impacts of climate change), in order to understand the most vulnerable coastal areas.

The Oregon coast is currently about 5% armored (22.5 miles). The majority of that armoring (92%) occurs in Clatsop, Tillamook, and Lincoln Counties. Tillamook and Lincoln Counties have the highest vulnerability to coastal erosion and highest potential for increased shoreline armoring, while Clatsop County has moderate vulnerability and the southern coastal counties of Lane, Douglas, Coos, and Curry have the lowest vulnerability to coastal erosion and future shoreline armoring. These differences are due to coastal population and development distribution, types of development, location of publically owned lands, and coastal processes that shape the coastline in different areas. The spatial analysis section of this report further breaks down these assessments by City and County.

Policy ideas are also explored in this report from changing statewide policy related to beachfront protective structure permitting and eligibility requirements, to adopting new local land-use policies to regulate development in coastal hazard zones. The ideas presented here are not exhaustive. In many ways, the state policies are already effective at regulating shoreline armoring equitably and broadly along the coast. On the other hand, local government policy changes or additions may be a more effective way to try to address some of the current policy challenges related to shoreline armoring and coastal erosion risks. Local efforts can be tailored to each jurisdiction and its unique geography and social context, and local efforts can be more restrictive than statewide policies. Several local policy ideas are explored in the Policy Ideas section of this report.

It is hoped that this analysis will help to better inform adaptation discussions and strategies to assist local jurisdictions, with the goal of increasing resiliency of communities to coastal erosion hazards. In addition to this report, new online spatial information about shoreline armoring locations and future eligibility is available through the Oregon Coastal Atlas. This information can be viewed online (www.coastalatlasc.net/oceanshores/) or downloaded as a data service. This data can be used as a decision-support tool for local planners, beachfront homeowners, and coastal managers.

Background

The Oregon coast is a beautiful and dynamic environment that draws people to the area to live, recreate, work, and enjoy. However, the high energy wave and wind environment of the coast can create a challenging setting for development and human life. Strong winter storms and erosion have led to loss of beach and property in many areas.

Various adaptation strategies have been employed or discussed for how to both protect property and the public beach, from shoreline armoring to managed retreat. These strategies can be controversial depending on the stakeholder group, but are important to explore collaboratively. The Oregon Coastal Management Program and the Oregon Parks and Recreation Department, in consultation with local and state partners, have created this document in order to analyze and integrate current public policy regarding coastal erosion and shoreline armoring with the latest relevant geospatial and natural science information (including predicted impacts of climate change), in order to understand the most vulnerable coastal areas. Additionally, it is hoped that this analysis will help to better inform adaptation discussions and strategies to assist local jurisdictions, with the goal of increasing resiliency of communities to coastal erosion hazards.

In addition to this report, new online spatial information about shoreline armoring locations and future eligibility is available through the Oregon Coastal Atlas. This information can be viewed online (www.coastalatlasc.net/oceanshores/) or downloaded as a data service. It is hoped that the data can be used as a decision-support tool for local planners, beachfront homeowners, and coastal managers (see *Results* section for coast wide armoring and eligibility statistics). For more details on the methods regarding the creation of these datasets, please refer to the appropriate methods documentation.

THE ISSUE

Coastal erosion and inundation (flooding) are two impacts experienced frequently and widely at the Oregon coast. Local variations and uneven distribution of development on the coast result in more damaging impacts to some areas over others. The northern and central coasts are more highly developed and experience higher impacts to development from coastal erosion. For example, in Tillamook County, the communities of Neskowin, Tierra Del Mar, Rockaway Beach, Cape Meares, and Pacific City experience high levels of erosion and/or ocean flooding. Many of these areas are low-lying, while others are built on highly-erodible dunes or bluffs. Dune-backed shorelines are some of the most highly erodible areas, but also the most attractive places to live. Much of the development in these areas occurred in the 1960s and 1970s, before people knew very much about coastal processes. Gleneden Beach, Salishan Spit, and Bayshore are similarly vulnerable communities in Lincoln County. The southern coast of Oregon, however, remains mostly undeveloped along the oceanfront with large tracts of publically-owned lands. A notable exception is the community of Nesika Beach in Curry County, which is experiencing high levels of erosion to bluff-dwelling homes.

There are several causes of erosion hazards occurring along the coast, including: 1) increases in total water levels (TWL); 2) changes to sand movement in littoral cells due to El Niño; 3) rip embayments; and 4) structural effects of armoring.

- 1) Total water level (combination of tides, surge, wave set-up, wave run-up, and sea level rise) is a way to measure wave damage and flood potential. In some areas, particularly in Neskowin, the width of the beach has decreased substantially; so during high TWL, wave energy has less area to dissipate before coming in contact with a structure, dune, or bluff toe, which can cause significant erosion to those areas.
- 2) During an El Niño event, sand can move dramatically in a littoral cell, taking sand away from one area and depositing it in another area. Typically, the sand will rotate back and the beach will recover; however, this did not happen after that last El Niño event in Neskowin, leaving the beach devoid of sand and vulnerable to high water levels. Conversely, Pacific City, on the north end of the littoral cell, has become sand inundated.
- 3) Rip embayments are localized areas of erosion where sand scour occurs and larger waves can reach shore. They typically form during high wave energy events where sand levels are lower. In some areas of beach, rip embayments are recurring, causing exacerbated erosion in those areas, like in Neskowin and Gleneden Beach.
- 4) Finally, structures built to armor the coastline can cause localized erosion damage. They can fail and/or unravel over time, especially when the structure's toe is not sitting on bedrock or when a structure is overtopped and subsequently becomes saturated from behind/beneath, causing mass failure. The angle of the structure is also usually steeper than a natural beach profile, increasing wave run-up.

CLIMATE CHANGE

There are many ways in which climate change will impact the Pacific Northwest, from increased wildfire hazards to more frequent intense rainstorms. For the Oregon coast, sea level rise (SLR) will likely be one of the most significant effects of climate change that will further exacerbate erosion and other coastal hazards. Additionally, increasing extreme storms and wave heights can be another factor impacting the coast.

Factors influencing SLR in the Pacific Northwest include melting of Alaskan and Greenland ice, tectonic processes, and ocean and atmospheric circulation. According to the National Research Council, the Oregon coast is currently experiencing slight vertical uplift (1.5-3mm per year) or sea level fall, with the southern coast of Oregon experiencing greater tectonic uplift than other areas of the coast (2012). However, the trend will likely reverse around 2030 because the rate of sea level rise will overtake the rate of tectonic uplift. Moreover, an earthquake along the Cascadia subduction zone will suddenly raise local sea level 1-2 meters. Sea levels have already risen in the region about 2.3mm per year over the last 50 years (OPRD, 2010). Current projections suggest sea level along the Northwest coast (Oregon and Washington) will rise 9-143cm by 2100 with large local variations (Dalton et al., 2013). Some of those

variations are due to ENSO (El Niño Southern Oscillation) and PDO (Pacific Decadal Oscillation), which affects sea levels on seasonal or decadal timescales. While the rate of sea level rise is relatively low on the west coast over the next 20-40 years, impacts from high water events and winter storms (which is when most coastal damage occurs) during ENSO, PDO, or even high astronomical tides, will be exacerbated. Additionally, the rate of sea level rise will continue to exponentially increase over time, becoming a more significant challenge. Lastly, some climate models predict that large waves are getting bigger and winds are getting stronger, which will also contribute to increased coastal erosion in Oregon (NRC, 2012).

On the Oregon coast, sea level rise means waves will break closer to the coastline and reach the cliff or bluff bases more frequently, increasing the rate of erosion and cliff retreat. Dunes are also predicted to retreat under rising sea levels and larger waves, threatening their natural buffering function as well as the development that has been constructed on dunes or barrier spits. With higher sea levels, especially in areas with hardened shorelines, beach accessibility is likely to decline as the width of the beach decreases. This is problematic not only for people who wish to access the beach, but also for marine animals who utilize the beach, such as seals for haul-out sites, and other tidally-dependent organisms. Hardened shorelines can also prevent habitat (like dunes or wetlands) from migrating upland with sea level rise. With increased levels of erosion, the threat to oceanfront development will increase, including to private property and public facilities and infrastructure. Under current law, public infrastructure (highways, public utilities, etc.) cannot be armored (see *Current Policies* section).

CURRENT ADAPTATION STRATEGIES

Shoreline armoring is the practice of using physical structures to mitigate the effects of coastal erosion along shorelines. The most common beachfront protective structure is riprap – large rocks placed to absorb the energy from waves. Other protective structures include retaining walls, seawalls and revetments. The number of permit requests to the Oregon parks and Recreation Department (see “Current Policies” section for more information) will likely increase, especially on the north and central coasts, given impacts of climate change and increased erosion.



Example of riprap on Oregon coast.

Shoreline armoring can adversely affect ocean beaches and neighboring properties. They can create erosion and other problems for adjacent areas due to local scour caused by wave reflection; they can alter sand movement and water currents and reduce public access to the beach; and they can create unpleasant visual and aesthetic impacts. Hardening the shoreline can also mean large stretches of the beach may be narrowed or even inaccessible during certain times of the day or year because the structures encroach onto the public beach. Additionally, armoring reduces the ability of beaches and dunes to adapt to new conditions by holding the shoreline in place rather than allowing the normal dynamic process to occur. Coastal development and the occurrence of several strong El Nino events has

led to increased coastal storm damage over the past several decades, despite protection from shoreline protective structures. Additionally, as sea levels and wave heights increase, overtopping of structures will become more frequent. Because seawalls and revetments cannot migrate landward as sea levels increase, they will eventually be inundated as well.

Pros of Riprap:

- Effective at dissipating wave energy
- Provide and maintain stability through weight and interlocking of individual stones
- Most cost effective measure for mitigating erosion hazard problems (since there is an abundance of basalt rock in the Pacific Northwest)
- Offer immediate protection of at-risk private property; help to protect communities and infrastructure behind the immediate oceanfront lots

Cons of Riprap:

- Increase wave energy near structure, which can accelerate erosion to neighboring properties and create rip embayments
- Can lead to domino effect: riprap leads to more riprap of adjacent properties due to localized erosion
- Alter natural character of the beach and can be aesthetically displeasing
- Disrupt natural shoreline erosion processes, locking up material from littoral cells use
- Wave overtopping is already occurring; property is not fully protected
- Designs are not well studied
 - Best practices are based on contractor knowledge and science is not well integrated into structure design
 - Designs may become larger in the future, resulting in further loss of the public beach
- Require constant maintenance over time because of their continual wave exposure; maintenance costs can get expensive and may be prohibitive in the future
- Can cause beach to steepen and lose sand, impacting beach access
- Disrupt natural ecosystems; grain size can increase after a structure is built

ALTERNATIVES TO SHORELINE ARMORING

There are some non-structural options available to help mitigate erosion, but their feasibility varies depending on the area, the costs of implementing such alternative options, and other factors. For example, the current definition of riprap in state law is written in such a way that may preclude some alternatives (see *Policy Discussion* for more details).



**Cobble Berm (dynamic revetment) at
Cape Lookout State Park**



Sand burritos with willow planting in Cannon Beach.
Left: During construction in 2002. Right: Two years after planting (in 2004).

When armoring is necessary, a dynamic revetment might be a feasible alternative that will slow erosion processes and work with the forces of nature rather than against them. A dynamic revetment involves placing cobble or gravel along the beach in front of the property to be protected and may be considered more aesthetically pleasing than traditional engineering solutions (if it matches the natural character of the original beach setting). An example of a cobble revetment is located at Cape Lookout State Park, where a septic field was at risk of severe erosion. This softer solution does reduce wave energy and prevent increased erosion; however, it does require high maintenance to keep the volume and placement of the cobbles at an effective level.

Vegetation and natural landscaping features have also been shown to help slow water or deflect wave energy. Coastal mudflats and marshes, eelgrass, plants and trees, wide beaches, dunes, and other topographic features have been shown in various instances to protect inland areas from inundation and wave damage. However, the effects of these features have not been well documented on the west coast. In particular, the Oregon coast is extremely vulnerable to high wind and waves, making alternative and “soft” solutions more difficult to develop and maintain. In some instances, fill and vegetation plantings have helped to stabilize shorelines in areas that have slightly lower wave energy environments. For example, in Cannon Beach, sand “burritos” (textile bags filled with sand and placed on the beach) together with a willow planting was used to stabilize a low bluff, rather than a traditional riprap, and it has been in place since 2002. Placement of natural materials such as woody debris in front of vulnerable dune or bluff toes can also be effective at mitigating erosion and mimicking the natural character of the beach.

Additional alternative options to riprap may include: beach nourishment; nearshore breakwaters; seawalls design with a return; structural adaptations (e.g. elevating houses on pilings); and managed retreat (e.g. moving houses away from coastline as erosion continues). Many of these alternatives are costly and/or unpopular, which is why they are generally not pursued. For example, offshore breakwaters may help the community of Neskowin by tripping waves in the surf zone; however this solution would cost tens of millions of dollars to build. Likewise, beach nourishment may be a solution in certain areas, but would require a suitable sand source and considerable funding to carry out and maintain over time. The small coastal communities of Oregon do not have the same level of demand

and tourism dollars invested as many coastal communities on the east coast to carry out beach nourishment projects. Land-use considerations and policies (like greater development setbacks) may be a more viable option for Oregon’s small coastal communities to address increasing erosion hazards.

Regardless of the type of option, alternatives to traditional riprap should consider adjacent habitats, shoreline energy, and wind and wave dynamics; there is no one-size-fits-all solution. More information about some of these alternatives and how they were considered for the community of Neskowin (in Tillamook County) can be found in the *Neskowin Shoreline Assessment* by ESA PWA. Some of these ideas are also further discussed in the *Policy Discussion* section of this report.

HUMAN ELEMENT

Oregon’s coastal cities and counties vary in their capacity to deal with coastal hazards, as well as in their potential for increases in population and development. While the greatest increases in populations are expected to occur in Lane and Douglas Counties by 2050 (according to Oregon’s Office of Economic Analysis), those increases will likely occur in the valley and not along the coast (as their coastlines are small and mostly publically-owned). Lincoln, Clatsop, and Tillamook Counties will also experience increases in populations by 2050 and those increases are more likely to happen along the coastal strip. It will be important for these jurisdictions to prepare for this increase by planning for resiliency to all coastal hazards, including erosion.

There may be various options for dealing with coastal erosion hazards, but there are just as many sentiments about what methods should be considered or carried out, as well as political realities and resource constraints, all of which are important to consider in coastal resource management and oceanfront development. The 1967 Beach Bill, signed by Governor Tom McCall, granted the public recreational access to Oregon’s beaches, up to the vegetation line. This public resource is strongly treasured by Oregonians. Many oppose shoreline armoring because it does encroach on the public beach to protect private property, while others (namely oceanfront homeowners) wish to be able to do whatever it takes to save their valuable homes and private property investments. This is not a new struggle, nor is it unique to Oregon’s coast. Many coastal states, particularly those severely damaged by hurricanes (e.g. Louisiana, Florida, New Jersey), are deciding whether managing the coastline through engineering and natural solutions is more feasible and cost-effective than moving communities away from the shorelines.

While the Oregon coast is much less developed than many other coastal states in the U.S., it does have an extremely dynamic and challenging coastal climate with significant existing development at risk from various coastal hazards. There is good information available about coastal erosion and shoreline armoring, but there are a lack of details addressing cumulative impacts of armoring structures, especially in regards to each littoral cell and its unique geography, development, and coastal environment. There is need for additional research and monitoring of shoreline armoring along the Oregon coast, in order to improve future decision-making regarding this issue.

Finding balance between the protection of private property and the protection of the public beach is a constant challenge that necessitates transparency, sound information, and extensive stakeholder input. Decision makers want to ensure they have the best available information to help them make decisions, as well as public input and support for those decisions. This analysis is meant to serve as a tool for coastal resource managers, land-use planners, and local officials by providing information regarding the challenges presented by coastal erosion, as well as potential options for mitigating its effects along the Oregon coast. The sections that follow provide information about the current policies regarding shoreline armoring, as well as an analysis of the current state of armoring and possible policy changes or additions for consideration, with the ultimate goal of increasing resiliency of communities to coastal erosion hazards.



Emergency riprap being installed during a winter storm event in Neskowin (Tillamook County, OR)

Current Policies

When much of the coast was initially developed, there was a lack of understanding of the coastal hazards and processes at work (i.e. in the 1950's through 1970's). Therefore, development was built on dunes, barrier spits, active landslide areas, and other areas at risk or actively exposed to coastal hazards. This situation in particular creates a tug-of-war between protecting private property and the rights of property owners with protecting the public beach and the beach environment. As a result of these issues and related conflicts, Oregon developed a set of state land-use policies which were put in place in 1977 and further clarified in 1985 to address this struggle.

In addition, under the Beach Bill enacted in 1967, the public has free and uninterrupted use of the beaches along Oregon's entire coastline. The Beach Bill also directs that the ocean shore be administered as a state recreation area. The Oregon Parks and Recreation Department (OPRD) is charged with the protection and preservation of the recreation, scenic, and natural resource values found on Oregon's ocean shore. Through its ocean shore rules, OPRD regulates various uses and activities on the ocean shore, as well as administers a permit program for ocean shore alterations. Ocean shore alterations include the construction of beachfront protective structures, beach access ways, sand alterations, the routing of pipelines and cables beneath the ocean shore, and natural product removal. Both the state land-use policies and the beach alteration rules work together to regulate shoreline armoring on the Oregon coast.

GOAL 18 BEACHFRONT PROTECTIVE STRUCTURE ELIGIBILITY

The State of Oregon has a set of state laws that mandate and regulate land-use, administered by local governments through their local land-use programs. The foundation of that program is a set of 19 Statewide Planning Goals. Oregon Statewide Planning Goal 18, Beaches and Dunes (OAR 660-015-0010), outlines where development and other uses can occur in beach and dunes areas, but also describes limits for the issuance of permits for beachfront protective structures (BPS). Implementation Requirement #5 stipulates that "development" must have existed on a property as of January 1, 1977 to be eligible for a BPS permit. Development is defined as:

- **Houses, commercial and industrial buildings;**
- **Vacant subdivision lots which are physically improved through construction of streets and provision of utilities to the lot; or**
- **Areas where an exception to Goal 18 Implementation Requirement #2 has been approved.**

Statewide Planning Goal 18 also requires that local comprehensive plans identify areas where qualifying development existed as of January 1, 1977 for the purpose of determining eligibility for BPS. However, because this requirement was added after most jurisdictions had already approved their Comprehensive Plans, most coastal jurisdictions do not have an official inventory of coastal parcels that are designated eligible and not eligible for BPS. A case-by-case method of making a determination is currently the most

common practice. However, as of 2014, a coast wide inventory of eligibility determinations now exists as a resource for all coastal jurisdictions to use. It is centrally housed with the Oregon Coastal Management Program, but can also be distributed to other jurisdictions as needed (many jurisdictions already have and are using this newly completed dataset, with some moving towards adoption of the inventory maps into their Comprehensive Plans to be in compliance with Goal 18 requirements).

OPRD BPS PERMITTING

The State also has a set of requirements under OAR (Oregon Administrative Rule) 736 Division 20, specifying the conditions in which a BPS can be permitted. These are implemented by the Oregon Parks and Recreation Department (OPRD). Permits are required for any ocean shore alteration, which includes BPS, because they often encroach on the public beach or are within the area of OPRD's permit authority (which is the area between extreme low water and the vegetation line). Some of the requirements for a BPS application include an analysis of hazard avoidance alternatives (e.g. moving a house back) and a geologic report on potential impacts of the proposed project and non-structural alternatives. In addition, the rule outlines standards (general, scenic, recreation, safety, natural and cultural) by which the permit should be evaluated. In the few cases where new BPS are approved, they must be designed and built to minimize adverse environmental effects.

A geospatial inventory was completed as of the end of 2014 to map the locations of all known BPS and their corresponding permit and repair information along Oregon's outer coast. This inventory and the eligibility inventory have been analyzed to start to address some frequently asked coastal management questions regarding shoreline armoring in Oregon, such as the current length of armoring and the future potential of armoring (see *Spatial Analysis Results* section). Shoreline armoring within estuaries are under the jurisdiction of the Department of State Lands and are not a part of this geospatial inventory.

LOCAL GOVERNMENT REGULATIONS

In addition to statewide policies that address shoreline armoring, local governments may (and some have) adopt land-use regulations (i.e. overlay zones, setback requirements, etc.) to reduce risk and the need for future BPS through such tactics as better geologic report standards (safest site), reduction in dwelling density in hazard areas, and moveable foundations for development in coastal hazard zones.

Both state and local policies are discussed further, with potential options for changes or additions, in the *Policy Discussion* section.

Spatial Analysis Results

The information that follows is in regards to what is currently known about existing beachfront protective structures, as well as eligibility for BPS based on current laws. All beach alteration permits submitted to OPRD have been included in this analysis through the end of 2014; the goal 18 eligibility inventory is complete and verified as of the end of 2014, as well.

Statewide Summary

Existing Beachfront Protective Structures

- 1, 290 total beachfront protective structures were mapped along Oregon’s oceanfront coastline (Figures 3 and 4)

An individual BPS corresponds with the length of one tax lot; however, multiple structures may belong to a single permit record (i.e. many property owners file a permit request jointly so their structures connect for maximum effectiveness). Additionally, multiple permit records may exist for the same structure, likely because the structure was rebuilt or an emergency permit was later replaced with a permanent permit, which is a current OPRD requirement of all emergency permits.

- There are 683 records related to permits for BPS (as of December 2014), though some of these records are for permit applications that were denied or withdrawn, or approved and never built.
 - 119 of those BPS permit records are designated as “unpermitted,” meaning a structure appears to exist in the location, but no formal permit was found corresponding to that structure.

Many undocumented BPS exist on Oregon's coast. Potential reasons for unpermitted structures are:

- They were constructed prior to permitting requirements (or at least before permanent records were kept);
- They were inland of the statutory vegetation line (and a permit was not required);
- Permit documentation may have been misplaced in a transfer between agencies; or
- The structures may be illegal.

Information on the location, characteristics, and condition of all structures on Oregon's ocean shore—not just permitted structures—is important in management decision-making (e.g. consideration of a new BPS permit application) and so an effort was made in this project to capture all (permitted and unpermitted) BPS. BPS can include many different types of designs. The inventory of structures in Oregon includes riprap revetments (most common), seawalls and/or retaining walls, vegetated or clay berms, beach access ways, gabions, geotextile pillows with plantings, cobble berms, and rock and log revetments. (For additional details on the database which houses BPS information, including permit and repair records, please see Appendix B.)

These structures total **22.48 miles of coastline** along Oregon’s coast, which makes up about 5.4% of the total coastline. The length of Oregon’s total coastline used in this analysis is 416.5 miles, which was derived from Oregon’s enhanced CUSP (continually updated shoreline product). A breakdown of miles of armoring per County can be seen in Figure 1.

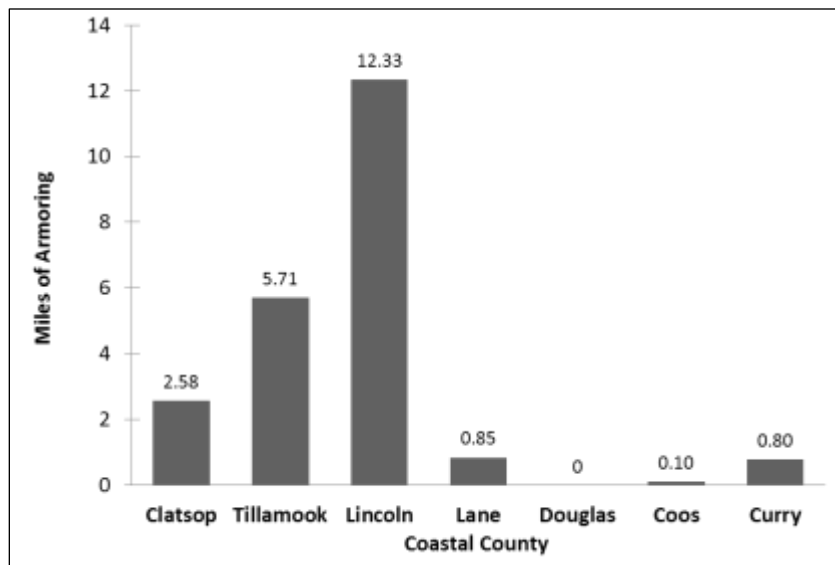


Figure 1 Miles of existing shoreline armoring per coastal county.

From Figures 1, 3, and 4, it is clear that the majority of armoring structures (92%) exist in the coastal counties of Clatsop, Tillamook, and Lincoln along the central and northern coasts. This trend corresponds to the most populated coastal areas. There are far less people living along the coast in Lane, Douglas, Coos, and Curry Counties. However, Tillamook County is an exception. With only about 23 people per square mile, its coastal area is sparsely populated but

extensively armored, indicating it is a highly vulnerable area to coastal erosion hazards. Other outside data and information supports this conclusion, as well. To see a further breakdown of these numbers per County, see the sections that follow.

REPAIRS

Number of BPS permits and repairs per year is shown in Figure 2. It is clear that the most applications for permits and repairs were made in 1999 (52 permits; 127 repairs), which was during and after a severe El Niño winter. Also, repairs appear to be increasing over time, while permits are staying relatively linear. As structures age, they are more likely to need repair and so it makes sense that requests for repairs increase over time.

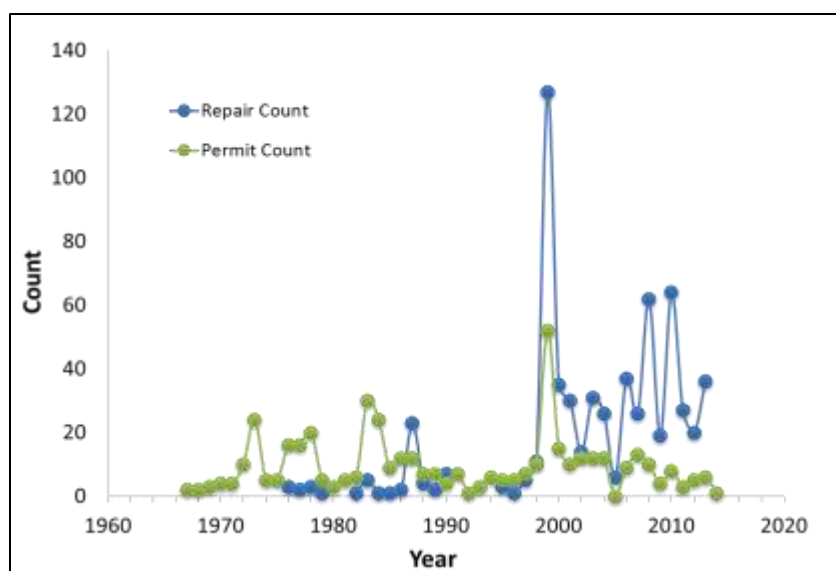


Figure 2 Numbers of BPS Permits and Repairs by Year.



Figure 3 Existing Beachfront Protective Structures (BPS) along the Oregon coast.

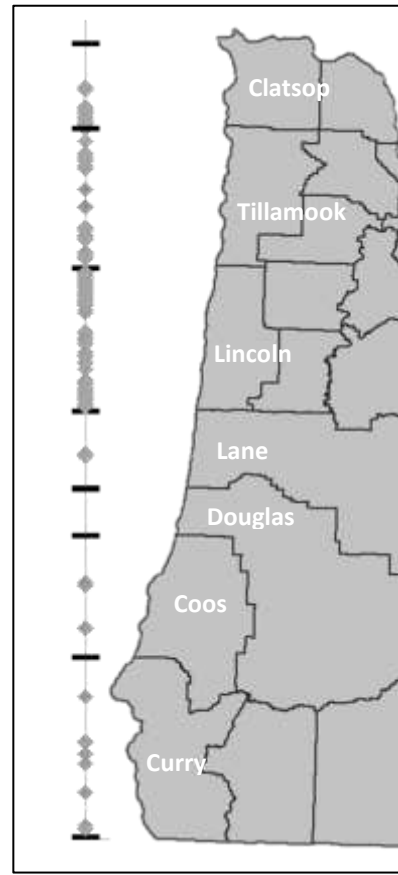


Figure 4 Center points of existing BPS distributed by coastal county.

The inventory contains a total of 631 repair records, all of which were recorded for Clatsop, Tillamook, and Lincoln Counties. The highest number of repairs made to one structure is 12, which was for a condominium unit in Neskowin (Figure 6). Thirteen structures have had six or more repairs. There are no recorded repairs in the southern coastal counties (Figure 5). Repairs may have occurred in these areas, but there is no record of them through OPRD.

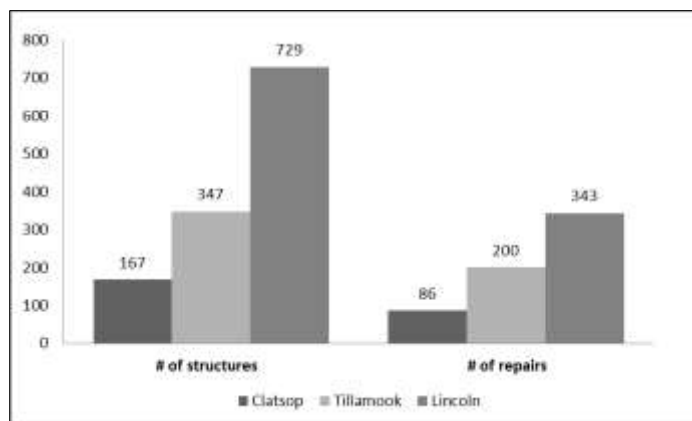


Figure 5 Number of structures and repairs for Clatsop, Tillamook, and Lincoln Counties.

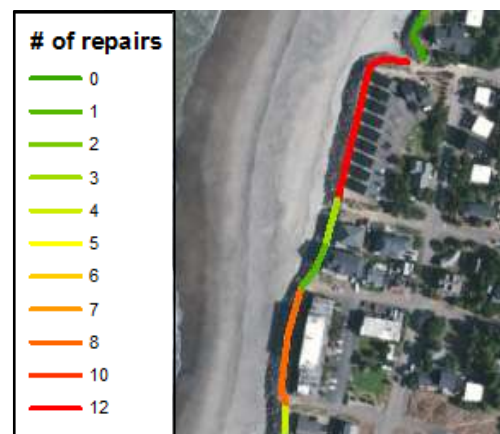


Figure 6 BPS by number of repairs.
Red line indicates 12 repairs.
Location: Neskowin, Tillamook County.

Eligibility for BPS permitting

For the coast wide inventory of eligibility determination for BPS permits, all coastal tax lots along the Oregon coast were analyzed. For details on the methods used to determine the eligibility status of these coastal tax lots, please see Appendix A. It should be noted that the Oregon coast includes a variety of land forms including rocky shores and some areas include a mix of these landforms. To insure the analysis was comprehensive, a determination was made on all parcels along the coast. Where it is determined through site-specific evaluation that particular properties are not subject to Goal 18, the BPS eligibility designation for these properties contained in the inventory does not apply.

As of the end of 2014, the coast contained 8,104 oceanfront tax lots with eligibility determinations. Of these, **3,332 are eligible and unarmored** and **3,460 are ineligible**. Those eligible and unarmored tax lots make up about 43 miles of coastline, which is almost double the amount of existing armoring. Not all of these areas are experiencing chronic erosion, but it is important to note this potential for future armoring and to look to these areas for alternative options. Most of this potential for armoring (71%) exists in Clatsop, Tillamook, and Lincoln Counties. However, that means the remaining roughly 350 miles of coastline is not subject to armoring, which is also a significant number. The sections that follow break down this information further, in order to determine where armoring exists currently, where it may exist in the future, and to better understand the most vulnerable coastal areas.

Figure 7 shows the number of coastal lots per County in terms of those designated eligible and armored, eligible and unarmored, and not eligible. **The percentages represent the portion of lots that are eligible and unarmored compared to all coastal tax lots for each county.**

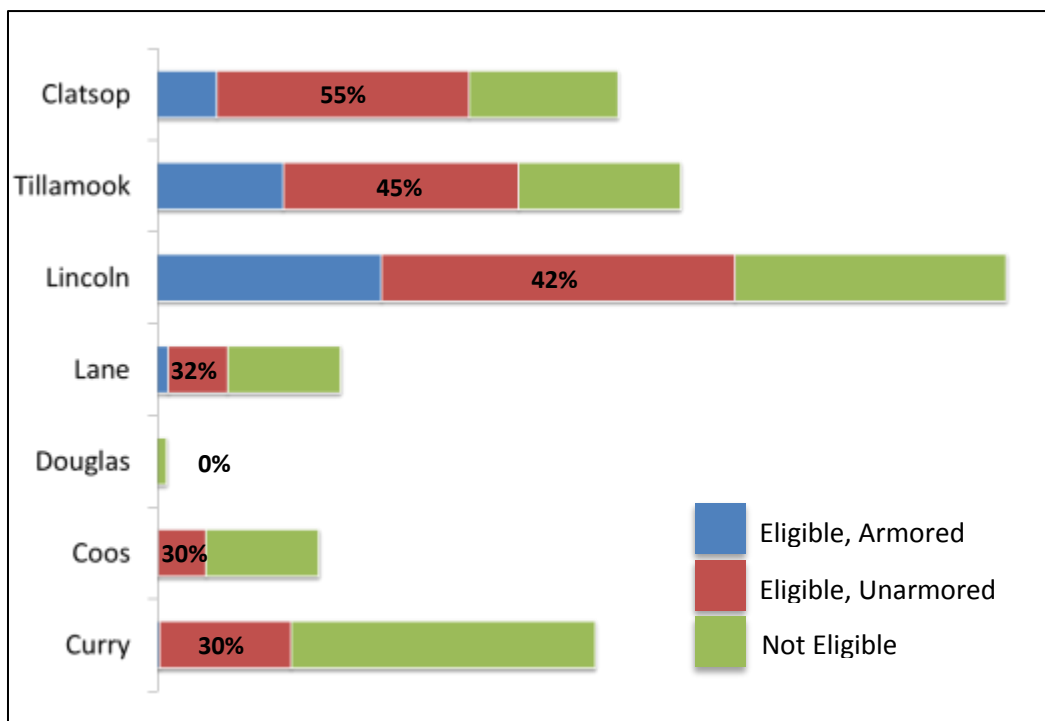


Figure 7 Number of eligible/armored, eligible/unarmored, and ineligible coastal tax lots for each coastal county.

Notes about how statistics were derived (for all jurisdictions):

- Vacant tax lots were derived using DOGAMI's building footprints in the coastal strip dataset, derived from 2009 LiDAR data, as well as visual inspection of aerial imagery.
- Urban Growth Boundaries (from 2012) were used to calculate numbers for each incorporated city with oceanfront mileage.
- Miles of Highway 101 along the oceanfront were approximated using a dataset from ODOT of Highway 101 line segments (those line segments that intersected the Goal 18 BPS Eligibility layer were considered oceanfront highway).
- The Goal 18 BPS Eligibility Inventory for the Oregon coast contains parcels that may not be directly on the oceanfront yet, but may become oceanfront in the future due to erosion. All parcels which contain an eligibility determination within this inventory were used in calculating statistics (except those with Goal 18 status of #5, which were left out since they are generally within the ocean shores state recreation area and are not developable).
- Ownership was used to determine whether coastal tax lots were publically owned. Publically owned tax lots include federal, state, and city or county owned land.

Clatsop County

Quick Facts:

- Population: 37, 474 (2014 estimate, US Census Bureau)
- Land Area: 829 sq miles
- Persons per sq mile: 45
- Oceanfront: 40 miles
- Existing Shoreline Armoring: 2.58 miles (6.5% of County coastline; 0.6% of total coastline)

Existing Beachfront Protective Structures

Overview:

- 167 beachfront protective structures, totaling 2.58 miles
 - Clatsop County contains over 11% of the armoring on the coast and is the 3rd most armored County.
- 88 permit records; 86 recorded repairs to BPS
 - 37 of these repairs occurred in 1999 (El Nino year), most in the City of Cannon Beach.
- Most of Clatsop County's BPS were built before 1990 (73 out of 82 permits).

Eligibility for BPS permitting

Overview:

- 1,422 total coastal tax lots
 - 963 tax lots are eligible (68%)
 - 184 tax lots are eligible and already armored

- 779 tax lots are eligible but not yet armored (81% of eligible lots)
 - 459 tax lots are not eligible (32%)
- 227 vacant oceanfront tax lots (excludes state parks lots)
 - 58 tax lots are vacant and eligible
 - 15 vacant lots are already armored (which includes 8 ineligible lots)
- 84 coastal tax lots are publically owned (6% of all tax lots; all are ineligible for BPS permits)
- 421 coastal tax lots are outside of UGB's in County jurisdiction (30% of all coastal tax lots)
- Approximately 4 miles of Highway 101 in Clatsop County are oceanfront

CITY OF WARRENTON

- The City's only oceanfront tax lots are part of Fort Stevens State Park or are County owned; all are ineligible to apply for a BPS permit. None of its oceanfront coastline is armored.

CITY OF GEARHART

- 0 BPS
- 230 coastal tax lots
 - 177 tax lots are eligible, all are unarmored (77% of tax lots are eligible)
 - 53 tax lots are ineligible
- 24 vacant oceanfront tax lots (5 eligible, 19 ineligible)

CITY OF SEASIDE

- 8 BPS
 - 4 permit records; 0 recorded repairs
- 396 coastal tax lots
 - 334 tax lots are eligible
 - 62 tax lots are ineligible
- 22 vacant oceanfront tax lots (8 eligible, 14 ineligible)

CITY OF CANNON BEACH

- 113 BPS
 - 61 permit records; 73 recorded repairs
- 363 coastal tax lots
 - 256 tax lots are eligible
 - 107 tax lots are ineligible
- 19 vacant oceanfront tax lots (11 eligible, 8 ineligible)

Tillamook County

Quick Facts:

- Population: 25, 342 (2014 estimate, US Census Bureau)
- Land Area: 1,103 square miles
- Persons per square mile: 23
- Oceanfront (miles): 70 miles
- Existing Shoreline Armoring: 5.71 miles (8.2% of County coastline; 1.4% of total coastline)

Existing Beachfront Protective Structures

Overview:

- 347 beachfront protective structures, totaling 5.71 miles
 - Clatsop County contains over 25% of the armoring on the coast and is the 2nd most armored County.
- 120 permit records; 200 recorded repairs to BPS
 - 32 of these repairs occurred in 1999 (El Nino year), and 45 repairs in 2008
 - Many of these repairs were in the unincorporated community of Neskowin.

Eligibility for BPS permitting

Overview:

- 1,615 total coastal tax lots
 - 1,116 tax lots are eligible (69%)
 - 389 tax lots are eligible and already armored
 - 727 tax lots are eligible but not yet armored
 - 499 tax lots are not eligible (31%)
- 426 vacant oceanfront tax lots (excludes state parks lots)
 - 206 tax lots are vacant and eligible
 - 72 vacant lots are already armored (which includes 5 ineligible lots)
- 72 coastal tax lots are publically owned (5% of all tax lots; all are ineligible for BPS permits)
- 1,094 coastal tax lots are outside of UGB's in County jurisdiction (68% of all coastal tax lots)
- Approximately 12 miles of Highway 101 in Tillamook County are oceanfront

CITY OF MANZANITA

- 1 BPS
 - 1 permit record; 0 recorded repairs
- 120 coastal tax lots
 - 70 tax lots are eligible
 - 23 tax lots are Goal 18 exceptions
 - 27 tax lots are ineligible
- 0 vacant oceanfront tax lots

CITY OF ROCKAWAY BEACH

- 115 BPS
 - 20 permit records; 37 recorded repairs
- 400 coastal tax lots
 - 22 tax lots are eligible
 - 364 tax lots fall with a Goal 18 exception
 - The oceanfront tax lots under a Goal 18 exception are also subject to the ocean setback line; land westerly of this line is not included in the exception area.
 - 14 tax lots are ineligible
- 66 vacant oceanfront tax lots (1 eligible, 61 subject to Goal 18 exception, 4 ineligible)

Lincoln County

Quick Facts:

- Population: 46, 406 (2014 estimate, US Census Bureau)
- Land Area: 980 square miles
- Persons per square mile: 47 (based on 2010 population)
- Oceanfront (miles): 73 miles
- Existing Shoreline Armoring: 12.33 miles (17% of County coastline; 3% of total coastline)

Existing Beachfront Protective Structures

Overview:

- 729 beachfront protective structures, totaling 12.33 miles
 - Lincoln County contains about 55% of the armoring on the coast and is the most armored County.
- 356 permit records; 343 recorded repairs to BPS
 - 66 of these repairs occurred in 1998/1999 (El Nino year)

Eligibility for BPS permitting

Overview:

- 2,621 total coastal tax lots
 - 1,783 tax lots are eligible (68%)
 - 693 tax lots are eligible and already armored
 - 1,090 tax lots are eligible but not yet armored (61% of eligible lots)
 - 838 tax lots are not eligible (32%)
- 604 vacant oceanfront tax lots (excludes state parks lots)
 - 223 tax lots are vacant and eligible
- 97 coastal tax lots are publically owned (4% of all tax lots; all are ineligible for BPS permits)
- 1,201 coastal tax lots are outside of UGB's in County jurisdiction (46% of all coastal tax lots)
- Approximately 33 miles of Highway 101 in Lincoln County are oceanfront

CITY OF LINCOLN CITY

- 242 BPS
 - 2 permit record; 1 recorded repairs
- 537 coastal tax lots
 - 505 tax lots are eligible
 - 32 tax lots are ineligible
- 63 vacant oceanfront tax lots

CITY OF DEPOE BAY

- 2 BPS
 - 136 permit record; 89 recorded repairs
- 112 coastal tax lots
 - 67 tax lots are eligible
 - 45 tax lots are ineligible
 - Most of Depoe Bay's oceanfront is rocky; the BPS eligibility requirement may not apply to most of this area, but a site specific determination would need to be made.
- 22 vacant oceanfront tax lots

CITY OF NEWPORT

- 26 BPS
 - 16 permit record; 3 recorded repairs
- 647 coastal tax lots
 - 305 tax lots are eligible
 - 342 tax lots are ineligible
- 256 vacant oceanfront tax lots

CITY OF WALDPOR

- 9 BPS
 - 3 permit record; 1 recorded repairs
- 38 coastal tax lots
 - 35 tax lots are eligible
 - 3 tax lots are ineligible
- 4 vacant oceanfront tax lots

CITY OF YACHATS

- 20 BPS
 - 7 permit record; 1 recorded repairs
- 78 coastal tax lots
 - 45 tax lots are eligible
 - 33 tax lots are ineligible
- 11 vacant oceanfront tax lots

Lane County

Quick Facts:

- Population: 358,337 (2014 estimate, US Census Bureau)
- Land Area: 4,553 square miles
- Persons per square mile: 77 (based on 2010 population)
- Oceanfront (miles): 35 miles
- Existing Shoreline Armoring: 0.85 miles (2% of County coastline; 0.2% of total coastline)

Existing Beachfront Protective Structures

Overview:

- 29 beachfront protective structures, totaling 0.85 miles
 - BPS accounts for 2.4% of the County's coastline and 0.2% of Oregon's coastline
- 5 permit records; 0 recorded repairs to BPS
 - Tax lots within "The Shores" subdivision are armored, despite not being eligible. In 1983, Division of State Lands (DSL) and the Parks and Recreation Division of the Department of Transportation granted emergency authorization for placement of riprap along the entire westerly boundary of The Shores Subdivision (2,680ft). A subsequent permit was granted by DSL for additional placement of riprap in the northern portion of the subdivision at Sutton Creek with County consistency approval; however, this riprap was not considered by the County to be within an estuary or on the ocean shore. Additionally, it appears that repairs have been made to ocean shore riprap along the northern section of the subdivision but no permit documentation can be located. Although it remains apparent that development within The Shores subdivision is not eligible for beachfront protective structures, this issue may be subject to debate in the future especially for repairs to existing riprap.

Eligibility for BPS permitting

Overview:

- 566 total coastal tax lots
 - 217 tax lots are eligible (38%)
 - 35 tax lots are eligible and already armored
 - 182 tax lots are eligible but not yet armored (84% of eligible lots)
 - 349 tax lots are not eligible (62%)
- 189 vacant oceanfront tax lots (excludes state parks lots)
 - 35 tax lots are vacant and eligible
 - 9 vacant lots are already armored (all of which are ineligible lots)
- 98 coastal tax lots are publically owned (20% of all tax lots; all are ineligible for BPS permits)
- 278 coastal tax lots are outside of UGB's in County jurisdiction (49% of all coastal tax lots)
- Approximately 18 miles of Highway 101 in Lane County are oceanfront

CITY OF FLORENCE

- 29 BPS
 - 5 permit records (4 of which are “unpermitted” – meaning no formal permit record found);
0 recorded repairs
- 287 coastal tax lots
 - 149 tax lots are eligible
 - 138 tax lots are ineligible
- 97 vacant oceanfront tax lots

Douglas County

Quick Facts:

- Population: 106,972 (2014 estimate, US Census Bureau)
- Land Area: 5,036 square miles
- Persons per square mile: 21 (based on 2010 population)
- Oceanfront (miles): 26 miles
- Existing Shoreline Armoring: 0 miles

Existing Beachfront Protective Structures

Overview:

- 0 beachfront protective structures
- 0 permit records; 0 recorded repairs to BPS

Eligibility for BPS permitting

Overview:

- 29 total coastal tax lots (all are in County jurisdiction)
 - 0 tax lots are eligible
 - 29 tax lots are not eligible (100%)
- 3 vacant oceanfront tax lots (excludes state parks lots)
 - 0 tax lots are vacant and eligible
 - 0 vacant lots are already armored
- 26 coastal tax lots are publically owned (90% of coastal tax lots)
- Approximately 3 miles of Highway 101 in Douglas County are oceanfront

Coos County

Quick Facts:

- Population: 62,475 (2014 estimate, US Census Bureau)
- Land Area: 1,596 square miles
- Persons per square mile: 40 (based on 2010 population)
- Oceanfront (miles): 68 miles
- Existing Shoreline Armoring: 0.1 miles (0.2% of County's coastline; 0.02% of total coastline)

Existing Beachfront Protective Structures

Overview:

- 6 beachfront protective structures, totaling 0.1 miles
- 6 permit records; 0 recorded repairs to BPS

Eligibility for BPS permitting

Overview:

- 499 total coastal tax lots
 - 151 tax lots are eligible (30%)
 - 3 tax lots are eligible and already armored
 - 148 tax lots are eligible but not yet armored (98% of eligible lots)
 - 348 tax lots are not eligible (70%)
- 149 vacant oceanfront tax lots (excludes state parks lots)
 - 17 tax lots are vacant and eligible
 - 1 vacant lot are already armored
- 99 coastal tax lots are publically owned (20% of coastal tax lots)
- 223 coastal tax lots are outside of UGB's in County jurisdiction (45% of all coastal tax lots)
- Approximately 1 mile of Highway 101 in Coos County is oceanfront

CITY OF BANDON

- 3 BPS
 - 3 permit record; 0 recorded repairs
- 276 coastal tax lots
 - 110 tax lots are eligible
 - 2 tax lots are Goal 18 exceptions
 - 164 tax lots are ineligible
- 79 vacant oceanfront tax lots (13 eligible, 66 not eligible)

Curry County

Quick Facts:

- Population: 22,335 (2014 estimate, US Census Bureau)
- Land Area: 1,628 square miles
- Persons per square mile: 14 (based on 2010 population)
- Oceanfront (miles): 106 miles
- Existing Shoreline Armoring: 0.8 miles (0.8% of County's coastline; 0.2% of total coastline)

Existing Beachfront Protective Structures

Overview:

- 12 beachfront protective structures, totaling 0.8 miles
- 13 permit records; 0 recorded repairs to BPS

Eligibility for BPS permitting

Overview:

- 1,352 total coastal tax lots
 - 414 tax lots are eligible (31%)
 - 8 tax lots are eligible and already armored
 - 406 tax lots are eligible but not yet armored (98% of eligible lots)
 - 938 tax lots are not eligible (69%)
- 318 vacant oceanfront tax lots (excludes state parks lots)
 - 54 tax lots are vacant and eligible
 - 0 vacant lots are already armored
- 108 coastal tax lots are publically owned (8% of coastal tax lots)
- 456 coastal tax lots are outside of UGB's in County jurisdiction (34% of all coastal tax lots)
- Approximately 54 miles of Highway 101 in Curry County are oceanfront

CITY OF PORT ORFORD

- 1 BPS
 - 1 permit record; 0 recorded repairs
- 159 coastal tax lots
 - 48 tax lots are eligible
 - 111 tax lots are ineligible
- 71 vacant oceanfront tax lots (19 eligible, 52 not eligible)

CITY OF GOLD BEACH

- 3 BPS
 - 4 permit records (2 “unpermitted”); 0 recorded repairs
- 190 coastal tax lots
 - 56 tax lots are eligible
 - 134 tax lots are ineligible
- 48 vacant oceanfront tax lots (15 eligible, 33 not eligible)

CITY OF BROOKINGS

- 2 BPS
 - 3 permit record; 0 recorded repairs
- 545 coastal tax lots
 - 175 tax lots are eligible
 - 370 tax lots are ineligible
- 87 vacant oceanfront tax lots (82 eligible, 5 not eligible)

Data Summary

From the spatial analysis and stakeholder interviews (see *Appendix C* for interview summaries), the coast can be qualitatively categorized in terms of vulnerability to coastal erosion hazards and potential for future armoring (high, moderate, or low vulnerability):

- **Clatsop County – Moderate**

- While Clatsop County does have a higher coastal population density than many of the other coastal counties, many areas have employed strict setbacks along the oceanfront and there has been significant sand build up over time which has created a natural buffer to erosion hazards in many areas (especially Clatsop Plains). The exceptions to this are those areas within the urban growth boundaries (UGB's) of Seaside and Cannon Beach, which have highly developed oceanfront areas. The most vulnerable area in County jurisdiction is Arch Cape.

- **Tillamook County – High**

- Tillamook County has a moderately low coastal population density, but has the second highest amount of existing shoreline armoring (5.7 miles, which is about 8.2% of its total coastline length). Also, about 45% of its coastal tax lots are eligible for armoring, but not yet armored. The City of Rockaway Beach and the community of Neskowin are especially prone to erosion and have significant amounts of development right along the oceanfront at risk from coastal erosion. Pacific City (and just north) also has a significant amount of armoring along the oceanfront; however, most of this is currently buried under sand due to sand buildup over the last decade. This area may become vulnerable again in the future because it is low-lying. Most of the oceanfront tax lots in Tillamook are in County jurisdiction (68%), which is important for the management of this area. Overall, with climate change factors and potential future population growth and development, Tillamook County's oceanfront is at high risk from coastal erosion.

- **Lincoln County – High**

- Lincoln County is the most densely populated coastal county and the most developed. It has the highest amount of existing armoring (12 miles, which is 17% of its total coastline length), and a high percentage of coastal tax lots that are eligible but not yet armored (42%). Many of its coastal cities, as well as areas in the County's jurisdiction are right along the oceanfront, with little buffer room, and are highly prone to coastal erosion hazards. Overall, Lincoln County's oceanfront is at high risk from coastal erosion due to its existing development, climate change risk factors, and future predictions for additional growth and development.

- **Lane County – Low**

- Lane County has very little existing armoring (0.9 miles; 2.4% of its coastline) and little oceanfront development along its coastline. Also, about 20% of its oceanfront tax lots are in public ownership (local, state, and/or federal), which will prevent armoring of those areas and provide room for natural erosion processes. Florence is the only City with oceanfront tax lots. Just north of Florence, within its UGM, a significant number of tax lots are already armored (although this armoring fronts ineligible properties that were permitted via an emergency permit by the Department of State Lands). This armoring is also mostly buried currently. Overall, Lane County has low vulnerability to coastal erosion hazards due to its low development and potential for development along the oceanfront.

- **Douglas County – Low**

- Douglas County has the lowest overall vulnerability to coastal erosion because 90% of its oceanfront tax lots are publically owned and 100% of its oceanfront tax lots are ineligible for shoreline armoring. No armoring exists and there is no potential for armoring. Additionally, there is little to no development near the oceanfront, so there is no significant risk from coastal erosion now or into the future.

- **Coos County – Low**

- Coos County also has low overall vulnerability to coastal erosion. Only 0.1 mile is already armored, which is 0.15% of the County's coastline. While many of its eligible coastal tax are not yet armored (~30%), 70% of its coastal tax lots are not eligible and 20% of its coastal tax lots are publically owned, so there is little potential for future armoring. Additionally, there is little development currently at risk from erosion hazards and future population projections remain low for this area. Bandon is the only city with oceanfront, and while some of its development may be at risk from erosion, it is not currently a coastal erosion "hot spot". Lastly, sea level rise is not a significant factor here for the next forty years because of tectonic uplift. Even as the rate of SLR increases into the future, it will have little impact on the County if oceanfront development remains low.

- **Curry County – Low/Moderate**

- Curry County has low to moderate overall vulnerability to coastal erosion. Of its 106 miles, 0.8 mile is already armored, which is 0.2% of the County's coastline. The majority (69%) of the County's coastal tax lots are not eligible, so there is low potential for future armoring. Port Orford, Gold Beach, and Brookings all have oceanfront tax lots and there is development at risk from erosion hazards in these areas, as well as some areas within the County's jurisdiction. The community of Nesika Beach (north of Gold Beach) is particularly vulnerable and has experienced significant bluff erosion which has substantially damaged a number of dwellings. Overall, Curry County's vulnerability is low; however, if more development were to occur along the oceanfront, vulnerability to erosion would increase.

Policy Discussion: Options for the Future

As outlined in the *Current Policies* section of this report, there are several state and local policies already in existence that address the permitting of shoreline armoring and development within coastal hazard areas. Overall, these policies are fairly comprehensive and effective at striving to balance the protection of the public beach and the protection of private property. The following are some strengths and challenges of the policies at the state level related to eligibility (Goal 18) and permitting (OAR 736 Div 20) requirements.

Strengths:

- Current policy limits and discourages shoreline armoring through the eligibility requirements (grandfathering of development on or before January 1, 1977)
- Eligibility for armoring based on this development date can be applied broadly to the entire coast
- Current policy process works well within the existing land-use framework

Challenges:

- Eligibility policy does not correspond with geography or physical processes
 - A “saw-tooth” pattern of eligibility can create problems for BPS permits
- Criteria for permitting structures (within OAR 736, Div 20) is ambiguous
- Vacant lots and street ends sometimes get armored
- Current science is not well integrated into structure design
- Knowledge gaps remain on cumulative impacts of BPS
- Current policies do not address climate change or future adaptation planning



"Saw-tooth" pattern of eligibility

This section aims to provide a few policy options that may strengthen or clarify, as well as expand upon, existing policies aimed at BPS permitting, eligibility, and development in coastal erosion hazard zones. Both state and local policy ideas are put forth for future discussions and next steps. This is not a comprehensive or exhaustive list, but rather a sampling of some of the ideas presented through stakeholder interviews, informal discussions with experts, and trends seen in the spatial data.

Statewide Policy Ideas

BPS PERMITTING REQUIREMENTS

Definition of BPS

Currently, there is no definition of “beachfront protective structure” in law. There is a definition for “riprap” and “structure” in the Definitions section of Oregon’s Statewide Planning Goals, and there is a definition for “improvement/alteration” in the Definition section of OAR 736, Division 20.

- *“Riprap”* – A layer, facing, or protective mound of stones randomly placed to prevent erosion, scour or sloughing of a structure or embankment; also, the stone so used. In local usage, the similar use of other hard material, such as concrete rubble, is also frequently included as riprap.
- *“Structure”* – Anything constructed or installed or portable, the use of which requires a location on a parcel of land.
- *“Improvement”* – Filling a portion of the ocean shore; removal of material from the ocean shore; or a structure, appurtenance or other addition, modification or alteration constructed, placed or made on or to the land (ORS 390.605(1)). For the purpose of these rules, the term “alteration” shall be used in place of “improvement” except as otherwise specified in these rules.

Currently, non-structural alternatives, like cobble revetments, may fall within the definition of riprap and so would need to meet Goal 18 eligibility requirements and OPRD permitting requirements. Many experts do not think a cobble revetment should be considered a riprap or structure because it is meant to mimic natural beach characteristics and move dynamically with beach processes, while others are concerned about cobble revetments as they have the potential to impact the natural beach and associated organisms. These issues will require further collaborative discussion.

Policy Option: Create a definition for beachfront protective structure (BPS) for the Statewide Planning Goals in order to clarify what is meant by BPS and what is subject to the Goal 18 eligibility requirements. It could be written so as not to include dynamic revetments, or other natural and non-structural options, but to ensure that all engineered and structural options are included and are subject to eligibility requirements (e.g. seawalls, riprap). Additionally, the definition of “riprap” should be updated to more accurately reflect what is meant by the word. This option may take some careful discussion and coordination with relevant stakeholders.

Ocean Shore Permit Application Review Process

As mentioned in challenges to current policy, some of the criteria for evaluating a BPS permit under OAR 736, Division 20 are ambiguous, which is acknowledged as an issue by many in this field. In the past (2012), a team of staff from OPRD did review the rule language with potential clarifications and updates. However, the process was never completed, and the rule language has not been updated.

Policy Option: If the issue were to be pursued again, there are many areas that could be further addressed or clarified in the rule language (OAR 736, Div 20), or through updating internal policies related to BPS permitting. Examples of things to address could be:

- Requirements for geologic reports:
 - All BPS permits would require a geologic report (not just for those greater than 50 feet in length). This option would require a rule change.
 - Additional report requirements as proposed by the Coastal Hazards and Processes Working Group, including addressing sea level rise and other climate change factors. This option could be achieved through policy changes.
- BPS built behind the statutory vegetation line – to address those “pre-emptive” structures that are built to protect private property outside of OPRD’s jurisdiction, mostly on properties that do not meet Goal 18 eligibility requirements.
 - A rule change to address these structures directly and clarify OPRD’s authorization to require homeowners to obtain a permit or remove these structures if a permit could not be granted once they are within OPRD’s jurisdiction.
 - Alternatively, local jurisdictions could require a permit process for the construction of these structures on a homeowner’s oceanfront property if proposed landward of OPRD’s jurisdiction. Eligibility could be determined at that time.
- Additional criteria for evaluating a BPS permit:
 - Threshold for relocating a house vs. building a BPS. Cost is usually the most common reason for not moving a house and instead wishing to build a riprap structure. However, additional factors could be evaluated besides cost to make a more objective and fair assessment of the feasibility of house relocation.
 - Cumulative impacts: a new BPS permit could be evaluated on its impacts to the entire littoral cell rather than just what is at risk for one property owner.
 - Include definitions of hard vs. soft engineering solutions so it is clear what is subject to eligibility and OPRD’s permitting requirements.
 - Include an emphasis on trying alternative solutions (e.g. vegetative plantings) to mitigate erosion before asking for a BPS permit. Applicant must show reasons why alternatives did not work.
 - A statement in rule to expressly prohibit homeowners from reclaiming their lost oceanfront property by filling in the beach.
 - Specific criteria for when to allow an emergency permit. For example, an emergency permit can only be considered when oceanfront property is less than 50ft from a house.
 - Criteria for when to allow the armoring of a vacant oceanfront lot. For example, only when BPS is required to protect houses on either side of the vacant lot, but otherwise, a vacant lot cannot be armored.
 - Design standards for riprap and seawalls. Currently OPRD staff depend upon recommendations as outlined in the geologic reports, but there are no design standards for BPS in rule.

DSL vs. OPRD Jurisdiction

Currently, jurisdiction can change between DSL and OPRD around creeks, rivers, and estuaries (e.g. when a creek changes paths). This can make permitting and other jurisdiction functions confusing.

Policy Option: It may make sense for OPRD to have complete jurisdiction over the mouths of small creeks that are subject to constant movement (e.g. Hunter Creek and Sutton Creek). These creek mouths could be mapped and placed into the jurisdiction of OPRD, with consultation from DSL.

Mitigation Banking

Mitigation banking resources could be used in the littoral cell in which a beachfront protective structure project is being built (or rebuilt), in order to offset or compensate for the expected adverse impacts of the BPS to the system. Some of the potential mitigation efforts could include creating or updating public beach access points, research and monitoring of the structure and cumulative impacts of armoring in the littoral cell over time, and/or local beach nourishment projects.

Policy Option: In addition to those revisions discussed above, an additional requirement could be added to OAR 736, Division 20 related to the permitting of BPS. An additional fee would be assessed on the homeowner(s) who submitted the application for: any new BPS built; significant rebuilds of existing structures; any repair over 50 cubic yards in volume; or any repetitive repair. The mitigation fees could be assessed on a sliding scale based on the magnitude of the project or repair and the decisions for how to use and distribute the money could be overseen by OPRD with input from other relevant state agencies and local stakeholders (e.g. OR Department of Fish and Wildlife, the Department of Geology and Mineral Industries, Oregon Surfrider Foundation, Oregon Shores Conservation Coalition, and the local jurisdictions). The main purpose of this requirement would be to try to further understand the impacts of BPS, mitigate for some of these impacts, and to transfer the burden of the costs of BPS to the oceanfront homeowners rather than the public.

GOAL 18 ELIGIBILITY REQUIREMENTS

Highway 101

Currently, under Goal 18, Implementation Requirement 5, only private property and infrastructure may be eligible for a BPS permit. Public facilities and development, including public roads, are not included in the definition of development in the Goal language. Some sections of state Highway 101 are oceanfront and vulnerable to the hazards of coastal erosion – about 123 miles total (though not all of this mileage is vulnerable to erosion). This highway is an essential lifeline road that connects coastal communities and



Figure 8 Sections of Highway 101 that are ocean-fronting.

provides connections back to the rest of the State. If the road were to become inaccessible, it could cause major challenges for transportation and safety. While there may be options for the road to be moved or re-routed in some areas, this option may be extremely costly; impact pristine or sensitive habitats; and/or be infeasible because of the mountainous and landslide-prone terrain.

Policy Option: An option would be to allow some sections of Highway 101 that are ocean-fronting to be included within the definition of “development” in Goal 18 Implementation Requirement 5 and allow them to apply for a BPS permit through OPRD. This option would apply only to Highway 101 (not any other public facility or roads), and only those sections that are at greatest risk from coastal erosion hazards. Most oceanfront sections of highway (Figure 8) occur in Curry County, but there are at least a few areas in Lincoln and Lane Counties that have had erosion issues in the past where this policy option may be needed. In order to move this issue forward, coordination would with the Oregon Department of Transportation would be required, as well as the relevant County and City officials, and any other affected stakeholder groups. These discussions have occurred in the past and were very controversial and would likely continue to be controversial.

Saw-tooth Patterns of Eligibility

There are some areas of the coast that have a problematic “saw-tooth” pattern of eligibility that may make BPS permitting difficult. This pattern occurs when an ineligible tax lot is surrounded by eligible tax lots. A continuous line of armoring is usually the most effective at mitigating the effects of erosion to private property. There is the potential for a few ineligible coastal tax lots to create gaps in an otherwise continuous line of armoring, which can exacerbate localized scour and create an uneven coastline.

Policy Option: For areas where this issue creates a problem for protecting eligible properties, a local jurisdiction could propose a Goal 18 exception to those properties that are currently ineligible. A strong case would have to be made for why the ineligible properties should be granted eligibility; for example, only those lots located on high bluffs and where the space between ineligible and eligible lots is no more than 150ft. This allowance would take some more in-depth thinking about criteria for granting an exception, which should include applicable state agencies. This option might include a tradeoff which potentially increases setbacks in some less developed areas (which would decrease the potential need for a BPS) if “saw-tooth” areas received decreased regulation.



“Saw-tooth” pattern in Gleneden Beach,

To reiterate, the ideas presented here for changes and additions to statewide policies are not exhaustive. In many ways, the state policies are already effective at regulating shoreline armoring equitably and broadly along the coast. Opening the policies up for revisions may prove problematic or politically infeasible. On the other hand, local government policy changes or additions may be a more

effective way to try to address some of the current policy challenges related to shoreline armoring and coastal erosion risks. Local efforts can be tailored to each jurisdiction and its unique geography and social context, and local efforts can be more restrictive than statewide policies. Several local policy ideas are explored next.

Local Government Policy Ideas

NESKOWIN MODEL:

The community of Neskowin in Tillamook County is particularly vulnerable to coastal erosion. The oceanfront lots are almost completely armored along the entire length of the community and there is little to no buffer of land between houses and the beach. The community came together in 2009, with help from the County and several state agencies, and developed a Coastal Erosion Adaptation Plan in 2013. This plan contains recommendations and actions, which strive to maintain the public beach and protect the community over the short and long term. These items have now been adopted into Tillamook County's Comprehensive Plan and Implementing ordinances.

Local Policy Option: The process Neskowin used to plan for coastal erosion, as well as the final recommendations, actions, and documents produced along the way, are all great resources that can be adapted and utilized by any local jurisdiction along the Oregon coast. This model may be a valuable resource to DLCD moving forward in assisting coastal jurisdictions dealing with coastal erosion and other coastal hazards. All of the recommendations can be utilized, though only a handful of those items will be discussed in this section.

ADDITIONAL LAND-USE REQUIREMENTS

A good way to reduce risk to coastal hazards is to reduce exposure. Removing or preventing development from occurring in the most vulnerable areas to coastal erosion and other coastal hazards is one way to reduce risk by reducing exposure.

Coastal Hazards Overlay Zone

Policy Option: Communities could adopt a coastal hazard overlay zone to identify areas subject to chronic coastal natural hazards (including ocean flooding, dune and bluff erosion, dune accretion, landslides, and inlet migration); and to manage development in these areas to reduce risk to life and property. Neskowin used mapping done by DOGAMI to outline their coastal hazard overlay zone. Any land that falls within this zone is subject to a set of additional provisions aimed at reducing exposure to coastal hazards. Some of the following ideas are from the work of the Neskowin Coastal Hazards Committee, while other ideas are from other stakeholder groups. Potential requirements for land within the Coastal Hazard Overlay Zone include:

- Strong setback minimums imposed on any new development or substantial improvement. This would be especially important in areas with vacant oceanfront areas that are still developable.
- A geologic report by a certified engineering geologist for any new development or substantial improvements, which should follow best practice guidelines for publishing such reports.
- Safest site – all new construction and substantial improvement should be located within the area most suitable for development based on the least exposure to risk from coastal hazards as determined in the geologic report.
- Not allowing development to occur if the geologic report says a house will only be safe if a BPS is constructed in front of the lot first. This is not consistent with the original intention of the Goal 18 eligibility requirement which was a grandfathering clause to protect homes that were already built. New development should take coastal hazards into consideration.
- Density restrictions – only single family homes permitted for new construction and substantial improvements. Additional dwelling units prohibited on lots with existing dwellings.
- Moveable structure design – to facilitate the relocation of structures that become threatened by coastal hazards (e.g. stem wall foundation systems). Alternatively, break-away walls on structures built on pilings may be an appropriate design for communities prone to coastal flooding.
- Hazard disclosure statement – signed by property owner acknowledging the property is subject to potential chronic natural hazards and the development is at risk of damage from such hazards; accepts and assumes all risks of damage from natural hazards; and understands the content of the geologic report for their property.
 - Local jurisdiction should also notify the landowner of the parameters of the Goal 18 eligibility requirement and let them know that partitions and further divisions of land may take away their eligibility status.

BPS Permitting at Local Level

As mentioned already, some homeowners have built beachfront protective structures behind OPRD's jurisdiction. At least in some circumstances, it appears that the intent could be to circumvent OPRD and Ocean Shore regulations as these structures are purposely built to protect the subject property at some future date. They can usually be found at properties that are ineligible and do not meet Goal18 requirements. OPRD cannot permit these structures, but local jurisdictions could.

Policy Option: If a homeowner wants to engineer a structure on their property to protect themselves from erosion at a later date, the local jurisdiction could require a development permit for this action. The permit could require compliance with Goal 18 eligibility since the structure's intention is to armor the coastline. Alternatively, this permit could notify the homeowner that once the structure becomes exposed and falls under OPRD's jurisdiction, they will be required to remove it (if the property is not eligible), or that an OPRD permit will be required.

Additionally, a local jurisdiction could require their own BPS permit for any BPS, even those that are already permitted by OPRD. This additional permit could further specify criteria for approving a new

structure, such as a more stringent alternatives analysis that focuses on moving development further back on the lot (regardless of cost), or requires a structure to be built at or behind the actual vegetation line wherever possible to minimize impacts to the public beach. This option would require significant coordination between the local government and OPRD.

Stormwater and Erosion Control

Coastal processes are not the only factors that cause erosion. Development practices and stormwater discharge can also cause erosion to land, which can lead to failure of dunes, bluffs, and BPS along the oceanfront. It is important for development practices in a community to address ways to reduce stormwater and implement erosion control measures.

Policy Option: All applications for development must show plans for control of erosion and sedimentation during construction and other ground disturbing activities. Applications for development should also include plans for long-term management of stormwater that accommodates increased runoff and provides permanent drainage.

Planning for the Future

Most jurisdictions do not have a plan in place for how to deal with development and infrastructure that becomes threatened by coastal hazards or for development and infrastructure that may become subject to hazards in the future. As sea levels rise and storms intensify, there may be a point at which houses are no longer safe to live in because of the risk. Not only will there be issues of displacement of the property owners, but also issues associated with the unsafe house (e.g. loose debris and beach impacts, septic system leaks, hazardous fuels and chemicals, etc.).

Policy Option: It may be of interest for communities, particularly those vulnerable to coastal hazards, such as erosion, sea level rise, flooding, and tsunami inundation, to initiate future planning for recovery from many different types of disasters and potentially reserving land away from the oceanfront for those who become displaced. This may include developing a local taxing district to help offset some of the costs associated with disaster relief or resilience capacity building.

Moving Forward

The challenge with changing land-use policies at the local or state level is that it can conflict with private property rights. Some of these ideas may be politically infeasible in certain jurisdictions; however, as time progresses and erosion and other coastal hazards continue to plague coastal communities, these ideas and others may gain traction. Options such as buyouts may become more feasible. The more proactive a community can be to start to think about and discuss these options, the more resilient they will potentially be moving forward. In addition, it is important to remember that planning for a tsunami, climate change, and/or natural hazards can be integrative and complementary; planning for one can help alleviate challenges from another.

With any of these policy options, especially those at the local level, funding and adequate staffing will be critical in implementing these changes. It will be important for the relevant state agencies to continue to give technical assistance, guidance, and financial support to local communities dealing with the effects of coastal hazards.

These policy options are meant to be a springboard for additional discussions around issues of shoreline armoring and coastal erosion along the Oregon coast. It is recommended that these and other ideas continued to be explored with interested and relevant stakeholder groups, especially in those communities most affected by coastal erosion (i.e. Tillamook County, Lincoln County, Rockaway Beach, Lincoln City, etc.), in order to refine ideas and decide whether changing or creating new policies is the right course to pursue.

Additional Resources

The following resources were used for background information in this report. They also may be useful resources for those interested in this issue and in the policy ideas section.

American Shore and Beach Preservation Association. 2013. *Storm protection: it's way more than that* [press release]. Retrieved from:
http://www.asbpa.org/news/newsroom_13BN0924_storm_protection_more.htm.

Dalton, M.M., P.W. Mote, and A.K. Snover [Eds.]. 2013. *Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities*. Washington, DC: Island Press.

Envision – Tillamook County Coastal Futures Project:
<http://envision.bioe.orst.edu/StudyAreas/Tillamook/>.

National Research Council. 2012. *Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present and Future*. The National Academies Press, Washington DC.
http://www.nap.edu/catalog.php?record_id=13389

Neskowin Coastal Hazards Committee. June 2013. *The Neskowin Coastal Erosion Adaption Plan*. Tillamook County, OR. <http://www.co.tillamook.or.us/gov/ComDev/>.

The Oregon Climate Change Adaptation Framework (OCCAF). Dec 2010. State of Oregon.
<http://oregonexplorer.info/FacingClimateChange>

OPRD (M.S. Lorang). 1994. *Coastal Erosion and Shore Protection: Conceptual Alternatives to Conventional Rip-rap Shore Protection Structures*. Corvallis, OR: Applied Coastal Science, Inc.

Oregon Parks and Recreation Department (OPRD). October 2010. *Climate Change Response: Preparedness and Action Plan*.
http://www.oregon.gov/oprd/NATRES/docs/oprdclimatechangeplan_forcommission_forweb.pdf

Appendix A

METHODOLOGY: GOAL 18 BEACHFRONT PROTECTIVE STRUCTURE (BPS) ELIGIBILITY INVENTORY

Outline

- 1) Overview – Goal 18 Requirements
- 2) Resources
- 3) Methods for Determining Eligibility
 - i) Determinations
 - ii) Subdivisions
 - iii) Other Assumptions
 - iv) Decision Tree
- 4) Using the Inventory

1) Overview – Goal 18 Requirements

The Oregon coast is a highly dynamic environment, which experiences strong winds, powerful wave activity, heavy rainfall, and has a complex geological environment. These factors cause many beaches and beachfront properties along the coast to be at risk from erosion and related processes. A potential safeguard against these risks is to install beachfront protection structures (BPS) that will minimize erosion of oceanfront properties. However, property owners wishing to install a BPS must apply for a permit (with the Oregon Parks and Recreation Department) to be granted authorization under Oregon's land use laws.

The State of Oregon has a set of state laws that mandate and regulate land use, administered by the Department of Land Conservation and Development (DLCD). Under Oregon Statewide Planning Goal 18, Beaches and Dunes (OAR 660-015-0010), the State limits the issuance of permits for beachfront protective structures. Implementation Requirement #5 stipulates development must have existed on the property as of January 1, 1977 to be eligible for a BPS permit. The conditions that satisfy the Requirement are:

- **Residential, commercial, and industrial buildings;**
- **Vacant subdivision lots with utilities installed and streets constructed; or**
- **Areas where an exception to Goal 18 Implementation Requirement #2 has been approved.**

Statewide Planning Goal 18 also requires that local comprehensive plans identify areas where qualifying development existed as of January 1, 1977 for the purpose of determining eligibility for BPS. To assist with this requirement, DLCD developed a draft GIS Goal 18 eligibility inventory for each jurisdiction along the Oregon coast (a catalog of coastal tax lots with areas identified where qualifying development existed on January 1, 1977). Many jurisdictions are now using the draft inventory to make BPS eligibility determinations. However, to be consistent with Goal 18, the inventory must be adopted into the local comprehensive plan. The 2013-2015 NOAA Coastal Management Fellowship project was established to:

- **Review and improve the existing inventory**
- **Work with local governments to insure inventory confidence**
- **Assist in county/city adoption of the inventory into local comprehensive plans**

Additionally, this eligibility dataset was developed to provide local governments, state agencies, and the public with a comprehensive map of the Goal 18 Beachfront Protective Structure (BPS) eligibility status of oceanfront lots in Oregon. The dataset can be used in local government planning, state ocean shore planning, and general public outreach and information. Local governments can use the GIS layer as a more efficient way to obtain information for customers or when processing or providing land use compatibility determinations on State permit applications. When reviewing permit applications, State and local governments will be able to use the mapping to identify potential conflict areas between eligible and non-eligible properties. The GIS eligibility layer can be used in combination with other layers such as dune and bluff hazard risk zone studies (Oregon Department of Geology) and the Beachfront Protection Structure database (Oregon Parks and Recreation Department) to determine areas of future BPS demand, areas of high risk development where BPS are prohibited, or unarmored shorelines where future beachfront protective structures could impact shoreline that is currently unaltered.

2) Resources

All coastal tax lots along the Oregon coast were reviewed through the NOAA Coastal Management Fellowship to determine or verify the parcel's development status as of January 1, 1977. The following information was used to make or verify an eligibility determination consistent with the requirements of Goal 18: Beaches and Dunes:

- 1967 & 1977 BW imagery of OR coast – digitized aerial photos from US Army Corps of Engineers
- 2009 & 2011 color aerial imagery of OR coast (for current conditions)
- County Records, including: tax maps, subdivision plats, tax information (e.g. year built dates), and surveys. Below is a list of many of the online resources available through the counties or the state.

(Many cities also have online resources available.)

- The Oregon Map - <http://www.ormap.net/>
- Clatsop County – <http://maps.co.clatsop.or.us/applications/index.html#>
- Tillamook County – <http://www.co.tillamook.or.us/gov/surveyor/Search/Default.aspx>
- Lincoln County – <http://maps.co.lincoln.or.us/>
- Lane County – <http://apps.lanecounty.org/SIDO/Default.aspx>
- Douglas County – <http://www.co.douglas.or.us/puboaa/default.asp>
- Coos County – <http://www.co.coos.or.us/Departments/Assessors.aspx>
- Curry County – <http://co.curry.or.us/Departments/Assessment>
- For a centralized list: <http://www.oregon.gov/dor/ptd/pages/county-taxlot-websites.aspx>
- Dates of state, county, and city subdivision laws
- Most recent tax lot geometry layer from every County
- County and City boundary layers, including Urban Growth Boundaries (from 2012)
- Statutory Vegetation line (denotes OPRD's jurisdiction/the ocean shores area)

3) Methods for Determining Eligibility

The original GIS Goal 18 eligibility inventory consisted of seven separate databases for each coastal county in Oregon. These original inventories were the starting points for the 2014/2015 review. Each County (Clatsop, Tillamook, Lincoln, Lane, Douglas, Coos, and Curry) was reviewed for accuracy (as outlined below) and updated with the newest tax lot geometry available (2013/2014). Each county was then migrated into a single personal geodatabase for the entire coast, which serves as the master database for the state. ArcGIS software (V.10.2) was used for the review and creation of the new inventory. The Goal 18 Master Database contains the following fields:

Field Name	Definition
Parcel-ID	Map & Tax Lot number of the parcel (shorthand). Format: Township-Range-Section-QuarterQuarter-TaxLot#
OR Taxlot	Cadastral standard for identifying tax lot in Oregon
Year Built	If known, date structure was built on tax lot; does not always reflect the earliest structure ever built
Comments	Contains final Goal 18 eligibility determination for that tax lot, as well as information relevant to that decision
G18 Status	1=eligible; 2=ineligible; *4=goal exception; 5=to be omitted from map visualization; 6= goal exceptions specific to Rockaway Beach, see City Planner for more
County	Numerical ID of coastal county from North to South (e.g. Clatsop=1 and Curry=7)
Viz	Y= yes this parcel should be visualized on the GIS; N= no, this parcel should not be visualized on the GIS (most likely because it is in the ocean shores area)
Shape Length	Auto-generated length of the polygon
Shape Area	Auto-generated area of the polygon

**NOTE: This inventory no longer contains a Goal 18 Status of “3”. This number represented “underdetermined” parcels in the original inventory. However, all parcels have been reviewed and given a clear eligibility determination, meaning there are no undetermined parcels remaining in the inventory.*

Determinations are made on a tax lot level, meaning each coastal tax lot is given an eligibility determination for BPS. This is because tax lots are the easiest way of visualizing geographically where development existed as of January 1, 1977. However, it should be noted that development is what is given an eligibility determination and does not necessarily cover the entire tax lot (see *Other Assumptions*). Steps taken to review each tax lot, as well as the reasoning behind the decisions, are given below.

- ❖ Each coastal tax lot was reviewed for qualifying development via ArcGIS Desktop software (V.10.2).
 - Lots already determined eligible for BPS and in a Goal 18 exception area were minimally reviewed to verify the determination and to expand upon the notes if necessary.

- Large eligible lots that have the potential to be further divided into the future had the following statement added to their “Comments” field: *NOTE: if property is further divided after January 1, 1977 - any qualifying structure remaining or any structure in a similar footprint to the original qualifying structure continues to be eligible for BPS; however, newly divided lots and new development are not eligible.*
- All other lots (undetermined, ineligible, and omitted) were reviewed systematically by County and geography (north to south).
 - ◆ Undetermined lots were those that required more time and resources than was given during the original inventory review.
 - ◆ Ineligible lots were those that did not qualify for BPS.
 - ◆ Omitted lots were not included in the original analysis usually because they were considered rocky shoreline or not oceanfront.
- The Oregon coast includes a variety of land forms including rocky shores and some areas include a mix of these landforms. To insure the analysis was comprehensive, a determination was made on all parcels along the coast, which may include some areas (primarily rocky shores) that are not subject to Goal 18. Where it is determined through site-specific evaluation that particular properties are not subject to Goal 18, the BPS eligibility designation does not apply.
- ❖ The resources listed above (historic aerial photography, subdivision information, survey records, etc.) were used to make a determination of eligibility for each reviewed tax lot.
 - In some areas, tax lots located further inland were added to the inventory because of future erosion potential.
 - Tax lots located mostly or entirely in the ocean shores area were identified and given a Goal 18 status of “5” (visualized as no color on a map) in order to decrease map confusion. These areas are usually in public ownership or have no development potential. However, the “Comments” field still contains information about the lot and whether or not it is eligible for BPS according to Goal 18, Implementation Requirement 5. The purpose for giving these lots a separate numerical designation is for map visualization purposes only. Local planners expressed their concern for mapping an ineligible property in front of an eligible property because it confuses homeowners as to whether their property is eligible (see graphic to the right, “5” status shown in blue). The lot shown in blue may not be eligible for a BPS permit, but the green lots are eligible.



Determinations

- If there is a qualifying structure on the tax lot as of January 1, 1977, then the lot is eligible for a BPS. If there is not a qualifying structure, the lot requires further review.
- If the vacant lot is not a subdivision and is not developed otherwise, then it is ineligible for a BPS. If the vacant lot is part of a subdivision, then other steps must be taken to determine whether it is eligible (whether it had utilities to the lot line). See *Subdivisions* below.

Subdivisions

Qualifying development as defined in Goal 18 includes “subdivision lots which are physically improved through construction of streets and provision of utilities to the lot” (utilities = water, sewer, and electric), which were created prior to January 1, 1977. The following assumptions were used to make eligibility determinations on subdivision lots consistent with Goal 18, Implementation Requirement 5:

- In defining development eligible for a beachfront protective structure, subdivision lots lawfully created by the recording of a subdivision plat were identified.
- If a subdivision was created after 1977, the lots within it were determined to be ineligible for a beachfront protective structure. However, development (a qualifying structure) located within the subdivision area that was created prior to January 1, 1977 may be eligible.
- Subdivisions further divided after January 1, 1977 are not eligible. However, development (a qualifying structure) located within the subdivision area that was created prior to January 1, 1977 may be eligible.
- If a subdivision was created prior to January 1, 1977 and after the date of the first subdivision ordinance implemented in the County or City (which generally required services to each lot), vacant lots within the subdivision were determined to be physically improved through construction of streets and provision of utilities to the lot as these subdivision ordinances generally required these improvements.
 - However, if further research showed evidence to the contrary (that utilities and streets were not present even though the subdivision ordinance at the time required them), the vacant subdivision lots were determined to be ineligible.
- If the subdivision was created before the first County subdivision ordinance, it must be more specifically demonstrated that services (road construction, water, sewer, and electric) were established to the lot line prior to January 1, 1977 in order to be eligible. This information could include: written information from applicable service districts, imagery showing road construction, other development nearby, or other documents siting construction of utilities. A decision-tree for determining services to these lots was developed as indicated below:
 - Are roads constructed to the vacant subdivision lot by 1977 date? (use aerial imagery)
 - No roads = ineligible for BPS
 - Yes roads = next step
 - Is there existing development (i.e. houses) requiring services in close proximity (i.e. adjacent or across) to the vacant subdivision lot?

- No = Assume ineligible for BPS unless further research (i.e. information from service district and/or assessor's office) demonstrates services are to the lot.
- Yes = Assume services existed to the vacant subdivision lot if houses are developed in close proximity; therefore eligible for BPS
- If a subdivision within a county is “unrecorded” and created before 1955 (the first state-wide comprehensive subdivision law that required filing a plat with the Clerk), then it is considered developed if services can be determined to the lot. If the lot is considered to be within an “unrecorded” subdivision created after 1955, it is ineligible because it is not a lawfully created subdivision. *(Note: This happened very infrequently)*

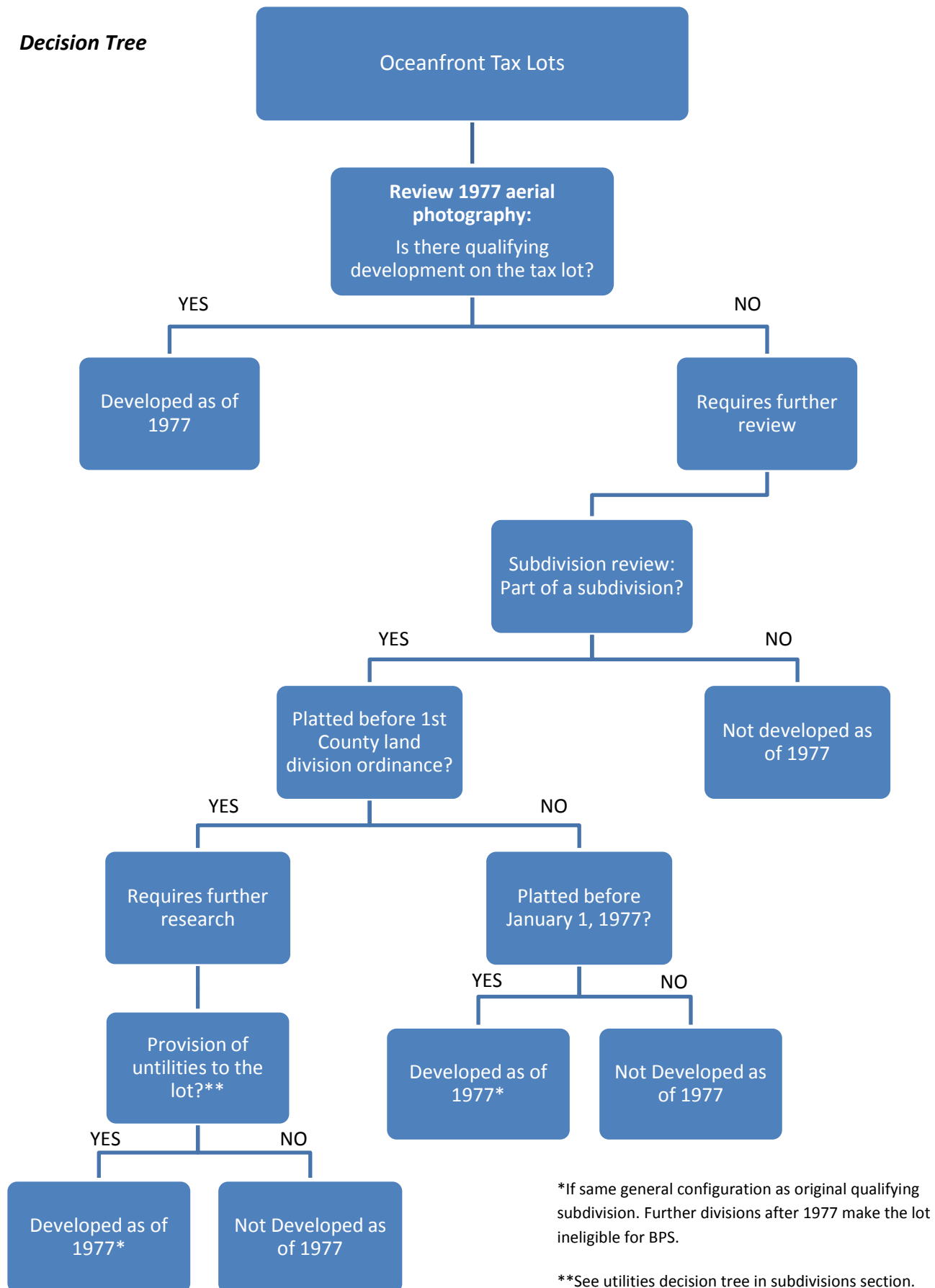
Other Assumptions Used with Analysis

Development vs. Parcel: Generally “development” is the key factor in determining eligibility, not a parcel where development may or may not exist. The following are examples encountered which have been vetted by legal counsel.

- Large Parcel with existing development (on January 1, 1977) where development is located a significant distance from the ocean shore. Determination: Not eligible for a BPS – erosion caused by ocean processes is not likely to threaten the structure in the foreseeable future.
- Qualifying development was present in 1977 but was removed with no development present at time of analysis. Determination: Not eligible for a BPS.*
- Qualifying development was present in 1977 but was removed and replaced with development which was located in the same general footprint of qualifying development. Determination: Eligible for a BPS.
- Qualifying development was present in 1977 but was removed and replaced with development that is significantly larger or more seaward than qualifying development. Determination: Not eligible for a BPS.
- Common areas of condominiums or townhouses are generally not considered eligible for BPS, though the condos or townhouses themselves may be. The notes associated with these parcels contain information about their eligibility. Eligibility refers to the development and not necessarily the land around it.
- State and County Park Facilities: Public campground facilities (tent/RV spaces, bathrooms, access ways, and other associated facilities) are generally not considered to meet the definition of “development” as defined in Implementation Requirement 5. It should be noted that in general, most significant development of county, state, or federal facilities is located away from the ocean shore and so would not qualify in any case, as indicated above.

**If it is possible to identify the building footprint of the pre-1977 qualifying structure, the applicant could propose, and the County/City may concur, that if the new structure was developed generally within the same footprint and no closer to the ocean shore that it may still be eligible for a BPS permit application.*

Decision Tree



4) *Using the Inventory*

Once the database was finalized in ArcGIS, the files could be exported as necessary and shared with various constituent groups. See metadata for more details about the data. The data was shared with local jurisdiction as they request it and can be further shared as requested. Through the Fellowship, an online viewing platform was created for this and other relevant coastal data in order to make it easily accessible to DLCD staff, coastal managers, city officials, coastal landowners, and any other interested parties through the Oregon Coastal Atlas (www.coastalatlus.net/oceanshores/). The Goal 18 eligibility data can be downloaded from the Oregon Coastal Atlas as well.

Recommendations for visualizing the data:

Goal 18 Status:

1 = green (eligible)

2 = red (ineligible)

4 = light green (goal 18 exception)

5 = no color

6 = stripes (Goal 18 exception that requires further review – Rockaway Beach area)

Recommended maintenance

Since the inventory is tied to tax lot geometry, it is recommended that local jurisdictions update the tax lot geometry of the Goal 18 Inventory every so often in order to keep it up-to-date (~every 2-5 years). If there are significant changes in oceanfront subdivisions and development or coastline erosion, they should be noted, especially if they impact the eligibility status of the affected tax lots. DLCD, as stewards of this statewide resource, should also plan to keep it maintained with any changes that local jurisdictions make to their local Goal 18 eligibility inventories and with the latest tax lot geometries for the coast.

It is hoped that many of the local coastal jurisdictions most affected by coastal erosion issues (e.g. Tillamook County, Lincoln County, Rockaway Beach, Cannon Beach, etc.) will adopt this inventory into their Local Comprehensive Plans as official inventory maps that represent the requirement outlined in Goal 18, Implementation Requirement #5. Many of these jurisdictions have been met with over the course of the 2013-2015 NOAA Coastal Management Fellowship and have expressed interest in adopting the maps. With additional guidance and assistance provided by the Oregon Coastal Management Program, they will be able to follow through on this process.

Appendix B

METHODOLOGY: OPRD SHORELINE PROTECTIVE STRUCTURE DATABASE

The Shoreline Protective Structure (SPS) geodatabase houses all information related to the permitting, location, repair, and status of shoreline protective structures (as permitted by the Oregon Parks and Recreation Department (OPRD)). The geodatabase contains general descriptive information, location (visualized as a polyline), repair information (if applicable), and photographs about each permitted structure as well as many “unpermitted” structures*. The purpose of this geodatabase is to encompass the most complete and accurate inventory of shoreline armoring for the Oregon coast in order to allow visual representation and spatial analysis of the data. It is also meant to be a centralized database for all current and future beach alteration permit records for OPRD staff going forward.

**Note about unpermitted structures: Many undocumented shore protection structures exist on Oregon's coast. Potential reasons for unpermitted structures: they were constructed prior to permitting requirements (or at least before permanent records were kept); they were inland of the statutory vegetation line and did not require a permit; permit documentation may have been misplaced in a transfer between agencies; or the structures may be illegal. Information on the location, characteristics, and condition of all structures on Oregon's ocean shores—not just permitted structures—is important in management decision-making (e.g., consideration of a new shore protection structure permit application) and so an effort was made in this project to capture all (permitted and unpermitted) shoreline armoring structures.*

Definition: Shore or shoreline protective structures = beachfront protective structures. There are many names given to shoreline armoring structures. DLCD uses beachfront protective structures because it is written in Goal 18; OPRD often uses the term shoreline protective structures. They both mean the same thing.

Project Background:

OPRD is responsible for permitting any construction or other beach alteration activities in the ocean shores area (west of the statutory vegetation line, or beach zone line). OPRD requires a property owner to demonstrate need for an erosion control structure, to explore any possible alternatives to hard structure installation, and to submit plans for a structure before a permit decision is made. According to Statewide Planning Goal 18, only those properties developed as of January 1, 1977, may be considered for a permit. In addition, OPRD considers potential impacts on the public's safe use and enjoyment of the ocean shores state recreation area and other factors as outlined in State Administrative Rule 736 Division 20.

SPS in Oregon were initially inventoried coast wide in the summer of 2002 by OPRD staff and mapped in a Geographic Information System (GIS), which provided descriptive information (such as structure height, width, length, and slope) and approximate locations of structures. However, the line was slightly

west of actual structures because a handheld GPS unit was used and staff could not stand directly on structures in the field. The geodatabase has not been updated with newly permitted structures since then, making the system outdated. A separate Microsoft Access database was kept by the OPRD Ocean Shores Coordinator for SPS permits, which was not synced with the spatial database created in 2002. Additionally, there was no mechanism in place to digitally enter and track repair permits. There was a need to create an updated SPS inventory and to integrate the permit tracking process (Access database) with the spatial component in order to have useable spatial data. The 2013-2015 NOAA Coastal Fellowship was created to integrate, update, and maintain a single geodatabase of SPS, which will complement an updated and verified inventory of Goal 18 eligibility status of coastal development (whether a development is eligible to apply for a SPS permit based on the requirements outlined in Statewide Planning Goal 18: Beaches and Dunes). Through the Fellowship, an online viewing platform was created for this and other relevant coastal data in order to make it easily accessible to OPRD staff, coastal managers, city officials, coastal landowners, and any other interested parties (www.coastalatlus.net/oceanshores/). The following is an outline of the methods used to create this integrated SPS database.

SPS Geodatabase Structure & Data Population:

A data dictionary outlining the fields for the geodatabase and their relationships with each other was agreed upon by the project team. The Project Team consisted of the NOAA Coastal Fellow and several key staff at OPRD, DOGAMI (Department of Geology and Mineral Industries), and DLCD (Department of Land Conservation and Development). Because the permitting process for SPS has undergone changes throughout its lifetime, a system for linking SPS permits with tax lots has been established to organize the information geographically. The database structure was built in ArcGIS by the OPRD GIS Program Leader and then populated with the SPS data from the Microsoft Access database (Figure 1). This data was checked for accuracy and updated as needed, using paper SPS permit files, the field data collected in 2002, and expert knowledge. Every known and/or existing permit record was read for relevant details about each SPS. Additionally, new data, specifically for SPS repairs and newly constructed SPS, was entered into the database and associated tables. Specific details and methods are outlined below.

Permit Table

The main database table is the Permit Table, which includes information about the SPS structure and permit information such as: permit application and decision dates; dimensions of the permitted structure; geomorphology of the area; and material type. The identifier for this table is the field, **Permit_ID**, which refers to the permit number of the entire SPS regardless of the number of tax lots associated with it. (For example, one Permit ID number may cover an area encompassed by ten tax lots because the homeowners applied jointly for one permit.)

- **Permit_ID** is the number given to each SPS permit in order to uniquely identify it. Prior to the creation of this database in 2014, permit numbers had the following format: BA-###-YY (BA for Beach Alteration and YY for the last two digits of the year built). From this point forward, Permit ID

numbers will be automatically generated when a new permit is entered by the new database and will contain only numbers.

- Unpermitted structures that did not have a BA# (no permit record found) were given a **Permit_ID** retroactively in order to identify them moving forward (see reasons for unpermitted structures above). These numbers were auto-generated by ArcGIS when the structure was entered into the database.

PERMIT TABLE DATA ENTRY

Permit information from the Microsoft Access ocean shores permit database was migrated into the new Permit Table. This information, along with the data collected in 2002 by OPRD staff, scanned pdf's of the original paper permit records, and any additional information deemed necessary was used to update and complete the new Permit Table to the extent possible. It should be noted that this table contains permit records for a variety of ocean shores permits, including those for cables, pipelines, stairways, sand alterations, and violations. Those permits not for a shoreline protective structure only have minimal data stored in the Permit Table and do not have a spatial component associated with them. The information recorded is listed in the table below (if the field is "null," the information was not found or available).

Field Name	Explanation
ObjectID	Automatically generated in ArcGIS
Permit_ID	Numeric Identifier of permit; Entered ObjectID number manually
PermitType	Type of permit issued. Choices: regular, emergency, withdrawn, denied, sand alteration, alternative (SPS other than a riprap or seawall), beach access, cable, fencing, miscellaneous, no permit, pending, pipeline, stairway, violation
Applicant	Name of property owners applying for permit
ApplicationDate	Date the permit was submitted as complete to OPRD
DecisionDate	Date the permit was issued by OPRD or applicable permitting agency
ConstructionDate	Date SPS construction was completed
OPRDoldnum	Original BA number assigned to the approved and completed Ocean Shore Alteration Permit. This number has been replaced by the Permit_ID number as of 2014.
DSLnum	If applicable, permit number assigned by Department of State Land's (DSL) permit database
USACOEEnum	If applicable, permit number assigned by Army Corps of Engineers' (ACOE) permit database
PermitHeight	Height of SPS (in feet) listed in permit. Cross section measurement.

PermitWidth	Width of SPS (in feet) listed in permit. Cross section measurement.
PermitLength	Total length of SPS given in permit (in feet). Generally north-south measurement.
Volume	Volume of SPS given (in cubic yards) in permit
RockDiameter	Riprap armor stone diameter given in permit, estimated to nearest .5 foot (if applicable). Stone usually measured at toe/base of SPS.
PrimaryMaterial	Dominant material(s) used in structure construction; choices = rock, wood, metal, cobble, concrete, culvert, emergency, fill, sand, stairway
Geomorphology	Landform type given in permit; choices = dune, bank, or bluff
PermitSlope	Slope of riprap revetment given in permit (in degrees)
PermitSVLWestWidth	Structure width west of Statutory Vegetation Line (in feet) given in permit
ToeTrench	Yes = toe trench present; no = no toe trench
Backfill	Yes = backfill present; no = no backfill used
FilterFabric	Yes = filter fabric used; no = no filter fabric used
ConstructMethod	Method of construction from permit info; choices = material placed or material dumped
Comments	Additional comments related to structure, permit or permit process
Creator	Person who created the record (automatically filled)
CreateDate	Date and time the record was created (automatically filled)
Editor	Person who last edited the record (automatically filled)
EditDate	Date and time the last edit was made to the record (automatically filled)
MaterialDescription	Additional materials used in the construction of the structure if not fully captured in the PrimaryMaterial field

Shoreline Protection Lines

The **Permit_ID** field links the Permit Table with the Shoreline Protection line layer. The Shoreline Protection line layer represents the location and length of the SPS along the coast. The identifier for this table is **Structure_ID**, which is unique to an individual tax lot and represents the SPS associated with that tax lot. Each line segment is linked to a permit record via **Permit_ID**. Both **Permit_ID** and **Structure_ID** are numeric values assigned randomly but are unique to each record.

The best available coastal aerial imagery and photographs were used to estimate the location of each known SPS. This consisted of aerial photography from 2009, 2011, and 2013 (using the most current when available; sources included County, State, and ESRI basemap aerial imagery). Oregon ShoreZone photographs (oblique aerials from June 2011) and field photographs from the 2002 inventory were also used when applicable. For structures that are currently buried by sand or vegetation, permit maps and information, as well as historic aerial photography were used to estimate the location of the structure (e.g. Bayshore near Waldport).

The digitizing of the SPS line was done by the NOAA Fellow using ArcGIS software. The line was drawn on the top-most (or east-most) part of the SPS. This line is also where OPRD's jurisdiction ends. Every tax lot associated with a SPS has its own line segment. These segments are connected, when applicable, to form the complete structure. The information recorded for the Shoreline Protection Line Table is described below:

Field Name	Explanation
ObjectID	Automatically generated in ArcGIS
Structure_ID	Numeric Identifier; Entered ObjectID number manually
Permit_ID	Number associated with the relevant permit for that structure, found in Permit_ID Table (refers back to original BA#)
ORTaxlot	Tax lot associated with the SPS line, in standard tax lot format
Comments	Comments associated with the structure
RepairCount	Number of repairs associated with that structure segment
Creator	Person who created the record (automatically filled)
CreateDate	Date and time the record was created (automatically filled)
Editor	Person who last edited the record (automatically filled)
EditDate	Date and time the last edit was made to the record (automatically filled)
Shape	Polyline (geometry field, auto generated)
Shape_length	Auto generated, length of SPS line segment

Repair Table

Structure_ID links the Shoreline Protection line layer and Repair Table. The Repair Table contains information related to any permitted SPS repairs, including application date and volume of material added to the structure. Each structure segment can have multiple repairs associated with it.

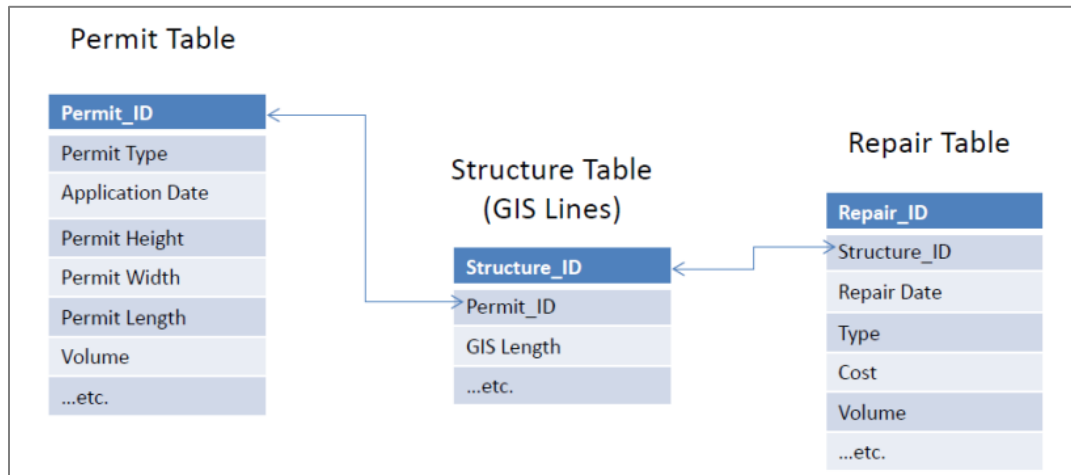


Figure 1 Basic SPS Geodatabase Structure

REPAIR TABLE DATA ENTRY

All OPRD paper records for repairs to SPS were entered into this table for every coastal county. Most records start in the mid-1990's, but some go back as far as 1976. The information recorded for every repair (if the data was available) is listed in the table below.

Field Name	Explanation
ObjectID	Automatically generated in ArcGIS
Repair_ID	Numeric Identifier; Entered ObjectID number manually
Structure_ID	Number associated with the structure segment for that repair record, found in the Shoreline Protection line table
RepairDate	Date on the Repair Application
PrimaryMaterial	Dominant material used for the repair; choices = rock, wood, metal, cobble, concrete, culvert, emergency, fill, sand, stairway
RepairVolume	Volume of additional repair material placed (in cubic yards)
RepairCost	Estimated cost of the repair (not usually given in permit)
Comments	Additional comments related to repair
Creator	Person who created the record (automatically filled)
CreateDate	Date and time the record was created (automatically filled)
Editor	Person who last edited the record (automatically filled)
EditDate	Date and time the last edit was made (automatically filled)
MaterialDescription	Additional materials used in the repair of the structure if not fully captured in the PrimaryMaterial field

With older records, multiple tax lots were associated with one repair permit. These records were listed multiple times in the Repair Table so that each tax lot associated with the repair permit has its own record in the table and own unique **Repair_ID**.

SPS Photos

Photos of all the known SPS were taken during the field study done in 2002, which remains the most comprehensive set of SPS photos. The Ocean Shores Coordinator continued to take photos between 2002 and 2005 of structures built in that time period. Additionally, photos were also taken in the field in fall and winter 2014/2015 to capture all those SPS that were built between 2005 and 2014. These photos can be found on the OPRD server (see Brady Callahan for more information). The photos may be linked to the SPS geodatabase at some point, but this linkage does not exist currently. Most of the photos taken in 2014/2015 are geotagged and so can be mapped as points in ArcGIS. The photos taken in 2014/2015 were given the following naming format: **Date photo taken_Permit ID #_Structure ID #_direction of photo**. (Example: 20140915_291_121_front) The photos of structures built prior to 2005 were given different naming formats.

Additional Notes about database creation and population

- For structures whose permits could not be found or that do not exist, a new record was created in the Permit Table, with a **PermitType** of “no permit.” Notes were written in the **Comments** field to describe any other known aspect of the unpermitted structure. Most of the other fields in the Permit Table are blank for these records because the information is unknown.
- Only shoreline protective structures were spatially digitized. All other permit records exist only in the Permit Table (for example, stairways, sand alterations, beach accesses, etc.).
- In some cases, a new permit was granted to a location that already had a shoreline protective structure present, likely because it was a significant rebuild or because it was a permanent permit replacing an emergency permit. In this case, the most recent **Permit_ID** number is listed in the SPS line table and the older **Permit_ID** number (if known) is listed in the **Comments** field. However, it is important to note that any previous permits associated with the structure are only linked to that structure through the **Comments** field; there is no relational component built in to the database currently to account for multiple permits associated with one structure.
- There are a few areas where it is believed there is riprap present but that it is currently buried underneath sand. Some of these areas have permits associated with them, but some do not. Expert knowledge and the 2002 field inventory of SPS were used to estimate these locations. The exact locations of these structures will not be known until they are exposed again in the future.
- Structures were only digitized in this inventory if they were on the outer coast of Oregon and/or within the jurisdiction of OPRD. SPS within estuaries are permitted differently than those on the outer coast, through the Department of State Lands and have not been digitized in this inventory.

Jetties were also not digitized in this inventory because they are permitted through Federal processes and not through OPRD.

Adding a new record

To add a new SPS record to the geodatabase in ArcMap, start a new Edit session. Enter a new record in the SPS Permit Table. Use information from the permit decision to fill in the fields: PermitType; Applicant; ApplicationDate; etc. Any beach alteration permit can be entered in this table, including for cables, stairways, dune grading, and others. All OPRD beach alteration permits should be housed in the same database for consistency and accuracy (even if the record does not include a spatial component). If there is no spatial component for the record, the update will be complete after entering information into the Permit Table. If the record is for an SPS, continue to the next step.

Draw a new line where the SPS is located (using “Create Features” from the Editor toolbar). An individual line should be created for each tax lot associated with the permit (if applicable). Make sure to anchor the end points of the SPS line segment to the tax lot geometry of each location associated with the permit (unless the structure does not span the entire oceanfront length of the tax lot). Then be sure to update the attributes of each new line segment. The fields to enter are: Structure_ID; Permit_ID; ORTaxlot; and Comments. ORTaxlot can be obtained from the information attached to the tax lot geometry; Permit_ID should be taken from the record in the Permit Table. This completes the process of entering a new SPS line.

To enter new repair information, enter a new record in to the Repair Table. Fill in information from the repair application: RepairDate, PrimaryMaterial, RepairVolume, etc. Also be sure to enter the Structure_ID number from the applicable SPS line segment. This links the repair record to the SPS. The final step for entering a repair record is to update the RepairCount field in the SPS line attribute table to accurately reflect the new repair. Make sure to save your edits.

Conclusions

Moving forward, interested stakeholders will be able to work with a comprehensive spatial database of shoreline armoring for the Oregon coast. It is recommended that the SPS database be continuously updated and maintained as additional beach alteration permit and repair records are submitted in order to have only one centralized database for beach alteration records. Since the SPS line records are tied to tax lot geometry of the coastal counties, and tax lot geometry changes over time, it is also recommended that the central database be updated every so often (~5years) to ensure that the line stays accurate. In the future, it may also be necessary to update the line using additional aerial photography or other information to adjust the east-west accuracy. Lastly, if interest or resources exist for this topic area, elevations of the shoreline protective structures could be evaluated on a coast wide level, which may be useful information for sea level rise and wave overtopping modeling. At this time, elevations were not able to be evaluated coastwide.

Appendix C

STAKEHOLDER INTERVIEWS - SUMMARY

Interviews were conducted with a total of six people from different stakeholder groups in order to gain a wide perspective on coastal erosion and shoreline armoring along the Oregon coast by the people who are most affected or involved in these issues. ***The interviews are summarized here for their main ideas. It is important to note that these summaries express the opinions of the interviewees and were not altered when summarized here. They also do not express the opinions of the Oregon Coastal Management Program.***

Interviewees and their affiliations:

- Bill Hall, Lincoln County Commissioner
- Charlie Plybon, Oregon Surfrider Foundation
- David Kraybill, Homeowner in Neskowin, Member of the Neskowin Coastal Hazards Committee
- Jay Sennewald, Land-use Planner for Rockaway Beach
- Jonathan Allan, Coastal Geomorphologist for DOGAMI
- Tony Stein, Former Ocean Shores Coordinator for OPRD

Most pressing coastal hazards facing the Oregon coast (listed alphabetically):

- Cascadia earthquake and tsunami
- Climate change
- Coastal flooding
- Erosion
- Overdevelopment close to the shoreline (can become hazards themselves once infrastructure and facilities are impacted by other hazards)
- Sea level rise
- Wind storms

Areas on the Oregon coast most vulnerable to beach erosion:

- Generally, areas with upland development close to the edge of the bluff in known geologic hazard areas
- North Coast:
 - Cove Creek area
 - Arch Cape
 - Cannon Beach
- Central Coast:
 - North of Yachats to Otter Rock
 - South Beach
 - Bayshore (too much sand right now, but has had erosion problems in the past)
 - Gleneden Beach & Salishan Spit (south of Lincoln City)

- Lincoln City from Spanish Head to Roads End
- Neskowin
- Pacific City
- Tierra Del Mar
- Netarts Bay, especially The Capes development
- Twin Rocks
- Rockaway Beach
- Cape Meares
- Nedonna Beach
- South Coast:
 - Nesika Beach (north of Gold Beach)
 - Lighthouse Beach in Charleston
 - Garrison Lake (north of Port Orford)
 - North spit of Coos Bay (however, no development here; just pristine dunes so don't hear about it)

Reasons for significant coastal erosion in these areas:

- Coastline characterized by pocket beach littoral cells with limited sediment inputs. Dune-backed shorelines are highly susceptible to erosion but are also the most attractive places to live in terms of views. Much of the development in these areas occurred in the 1960s and 1970s when people didn't know very much about coastal processes and hazards.
- In certain areas, storms have increased and direction of the storms has changed, which has affected the give and take of the sand in a littoral cell, leaving some areas more deprived of sand than others (Neskowin is sand deprived, whereas Pacific City has too much sand).

Benefits and drawbacks of beachfront protective structures (BPS) as strategies to combat erosion:

- Benefits:
 - Most cost-effective measure for mitigating erosion hazard problems (there is an abundance of basalt rock in PNW)
 - Harder to build concrete seawalls because basement rock is too far below the sand in many areas here
 - Effective at dissipating wave energy
 - Allows for immediate protection from erosion hazards of private and public facilities and infrastructure along the coastal strip; can be considered short and long term protection solutions as well
 - Can save significant short term costs in terms of damage and destruction of property and infrastructure
 - Save very valuable property/personal investments
 - BPS are sometimes also protecting the communities and infrastructure behind them in addition to the immediate oceanfront lots
 - Short term solution to protect oceanfront property

- Financial costs of building, maintaining, and repairing riprap are responsibility of the oceanfront homeowners
- Drawbacks:
 - Aesthetically displeasing
 - Current best practices in riprap design are not science-driven, but based on past experiences by contractors
 - Already wave overtopping in some areas (Neskowin); which means property is not fully protected
 - Structure designs have appeared to improve over time (stone is keyed in and carefully placed); but not clear if this design is more effective or not at wave dissipation Neskowin has some of the highest rates of repairs but the best riprap design
 - One structure leads to another structure because of localized erosion effects but there is no overarching planning or thinking about BPS in a comprehensive way (just case-by-case)
 - BPS will have to be rebuilt and repaired over years and decades (depending on location, beach profiles, and local geologic conditions) because of their constant exposure to wave and storm surges
 - Cost of repairing riprap over time is expensive
 - Maintaining or rebuilding riprap may become cost prohibitive over time, especially if the beach is completely lost and the ocean comes right up to the edge of the riprap
 - BPS may become larger, wider, taller, more fortified, and take up more beach area in the future, resulting in further loss of recreational public use
 - Narrowing of the public beach over time
 - Continuous repairs and rebuilds can cause continuous loss of sand and may create artificial headlands – meaning structures may block beach access in the north/south direction
 - Compromises the integrity of the beach; the beach steepens and sand is lost, leading to impacts to public beach access
 - Disrupt natural ecosystems, especially for sandy bottom and sandy shore habitats; grain size can increase after BPS is built and change this habitat
 - BPS don't solve the problem, just shift it north or south
 - Impacts to public beach, visual impacts, impacts to beach habitats
 - Political issue; many people do not like armoring of the coast and especially the impacts to the public beach
 - Many people do not know about the eligibility requirement for BPS and only know of the 1967 Beach Bill which made Oregon's beaches public
- Other:
 - Will be difficult to stop a homeowner (who is eligible) from riprapping their property if they feel it is in danger
 - Will be difficult to continue to balance protecting private property and protecting the public beach as the beaches continue to erode back to existing development

BPS impacts to beach access:

- Stretches of Gleneden Beach and Neskowin are not accessible at high tide
- In some areas, riprap has been placed like a stairway at street ends which helps to ensure beach access; however, not fully accessible to elderly or handicapped
- Natural shoreline erosion processes are being permanently interrupted and altered by the locking up of potential sand, soil and cobble stored in coastal dunes and bluffs. The material becomes unavailable to supplement beaches and littoral cell budgets.
- Significant lengths of BPS's can affect wrack line position and food resources for species that are dependent on that biological zone.
- Artificial headlands can form as BPS's become larger and extend further into the beach/surf zone, resulting in the loss of recreational beach area.
- Localized scour from BPS's can accent and possibly increase the size and scope of rip embayment's that set up near or in front of BPS's.

Known Pre-emptive BPS:

- Development south of South Beach State Park (Southshore) – built a riprap-type structure behind the SVL and then buried it/re-vegetated it; will eventually become a riprap structure when fore dune erodes away eventually (these properties are not eligible).
 - What will happen then? Will riprap be removed from the beach?
- There is a perception that once riprap is on the beach, it never gets removed. Some emergency permits don't become permanent.
- Illegal BPS that are built without a permit while inside OPRD's jurisdiction are rare but do occur on occasion. They are usually reported by the public and OPRD sends a Letter for Compliance or a Notice of Violation to the property owner.
- BPS that are built outside of OPRD's jurisdiction do occur, and there are a number of examples to be found on the coast. A permit is not required for these structures by OPRD because they are outside of OPRD's jurisdiction at the time of construction. The intent appears to be a circumvention of OPRD and Ocean Shore regulations as these structures are purposely built to protect the subject property at some future date. They can be found at properties that are ineligible and do not meet Goal18 requirements.
 - It appears that the property owner has the intent to deal with or negotiate with OPRD when they are eventually exposed and within OPRD jurisdiction.

How BPS designs are changing:

- Solid basalt rock is used most often because it doesn't crumble easily
- Largely designed by past experiences of contractors, but without knowledge of coastal engineering principles – would be much larger structures if that were the case
- In the past, rocks were dumped down a slope and allowed to settle via gravity. Now, rock is being placed carefully, with a layer of filter fabric and finer gravel. Not sure if that is more effective or just more aesthetically pleasing since Neskowin (which has carefully placed riprap

structures) has some of the highest rates of repairs. But in many places the structures are just built on top of sand, so they are likely to fail no matter how well built.

- Top design elements for an effective BPS:
 - Strong geotechnical experience in coastal design with an understanding of specific geologic site conditions, knowledge of local wave-run-up height, appropriate structure slope and height for rip rap structures at the location
 - Use of materials that include filter fabric, pit run backing material and the placement of solid basalt rock of adequate size for the specific location
 - Excavator operator experience in specific coastal areas is critical to good riprap placement and construction techniques
 - For concrete or wood seawalls: the use of designs that rebound wave run-up on the structure; curved concrete walls can redirect and dissipate wave energy, as well as provide extra protection for the toe of the structure.

Alternatives to shoreline hardening and their pros and cons:

- No one size fits all solution
 - Options for dealing with erosion and other coastal hazards should consider adjacent habitats, shoreline energy, wind and wave dynamics
- Most engineering alternatives are not viable because they are too expensive
 - Offshore breakwaters – might be very effective at tripping waves in surf zone, mitigating energy offshore, but cost tens of millions of dollars
- Cobble berms (dynamic revetment)
 - Example at Cape Lookout State Park – some success but high maintenance
 - Problem is finding a cobble source and transportation of those cobbles to the beach location is costly and logistically difficult
 - Have to prove that you are not changing the character of the beach
 - In order for this to be effective, it requires huge volumes of cobble and long-term maintenance
- Softer solutions: (these would work best in areas or during times of low to moderate storm surge and wave run-up – generally wide flat beaches with small grain size)
 - Vegetation stabilization – at least one example in Cannon Beach (willow planting) that is holding up well there.
 - simple placement of sand with vegetative plantings,
 - non-structural placement of large woody debris with or without a sand cover and vegetative planting
 - Dynamic cobble revetments and placement of natural materials found on the ocean shore (sand, wood, cobble) that are placed in a manner that mimics natural beach processes.
- Any alternative will have some level of maintenance, oversight, and management
 - There are many solutions (engineered or otherwise), but the Oregon coast is a challenging environment and riprap ends up being the most cost-effective solution

- Beach nourishment is a potential option – but need to think about where sand comes from and who is paying for the nourishment
 - Has worked in certain areas of California
 - Need to find a source of sand and a method for placing the sand on the beach (or just offshore, allowing it to be pushed onshore)
- Personal responsibility should ultimately be on the homeowner for whatever option is considered
 - Guidance from the government and improved rules and policies can help with that (including financial assistance programs)
 - Dealing with small coastal communities in Oregon; public tax money probably can't pay for these options and private communities can't afford alternative options (very unlike the large coastal communities on the east coast with large amount of tourism dollars)
- Proactive measures for future development; discouragement of development in hazard zones
 - Don't allow vacant lots to be rippedrap
 - Increased setbacks
 - Mobile houses in hazard zones (not trailers, but modular homes, or structures that can be moved out of harm's way)
- Clarifying/strengthening permitting policies to ensure armoring is the last possible option
- State and local jurisdictions should work together more effectively on addressing development in hazard areas – state wants to follow a bottom-up approach but sometimes jurisdictions don't want to enforce stricter guidelines without having the state require them
- Neskowin research found most engineering solutions would not work in Neskowin (mainly due to high cost and high energy environment) other than maintaining riprap
 - Other options were land-use based
- If homeowners can no longer afford to maintain or repair their riprap, who responsibility is it? Do other community members come together to pay? Public?
 - Potential option to create a local taxing district for maintaining riprap at a community-wide level
- Preserving land that is undevelopable oceanfront or in hazard zones to ensure public beach access and/or to allow natural beach processes to occur unimpeded.

Research topics to further investigate:

- From a decision-maker perspective, want to ensure the data is current and the best available to help with decisions
- Beach impact analysis – monitoring of the impacts and effectiveness of a structure once it's built in to see impacts to the ecosystem, the recreational uses, and physical environment
 - Would like the beach to be profiled before and for a period of time after a structure is built
 - Species assemblage, grain size analysis
- Why is Tillamook County so prone to erosion? Why is shoreline re-orientation taking place here? (buildup in north, eroding back in south)

- Further research in to littoral cell sand transport (e.g. are headlands barriers to sand transport or is there leakage around them?)
- Study specific areas of high development on the coast, to understand the geology, available sediment from coastal bluffs and dune types, stream and river inputs and uniqueness of each area.
- Look at the long term effect of shoreline armoring on a specific stretch of coastline or littoral cell.
- Investigate the benefits of increasing the use of curved or vertical concrete seawalls. Would they be more effective in retaining sand or protecting the beach?

Effectiveness of current policies:

- Yes the current policies are effective. They have kept SPS armoring in check and allow managers to be flexible in decision making. The oversight from Goal18 and Division 20 appears to be working well.
- There are improvements that could be made in Division 20 that could help the regulatory program become more effective and assist the permit program address specific standards when evaluating an application.
- Current policies are fairly effective and conservative; however nature changes regardless of policy
- Lack of public understanding of Goal 18 eligibility, especially in terms of how it relates to the Beach Bill
- Goal 18 is failing in areas where properties are categorized as eligible or not eligible based on the law, but it doesn't necessarily correspond well to what is developed on-the-ground there right now
 - Belief that eligibility won't matter if a homeowner is in danger of losing their house and they are ineligible; they will be able to riprap anyway by hiring good lawyers
- Policy does not account for saw tooth areas – eligible property next to ineligible property that is still subject to significant erosion – what will we do in those areas? Let them become indented or allow armoring?
- No comprehensive plan for riprap – should be done at a littoral cell scale (physical level of impact for erosion)
 - A feasible approach would be to look at littoral cells and identify areas we can save and areas we cannot and develop mechanisms for retreat in those areas.
 - Including plans for where to relocate and how to dismantle infrastructure
 - Should happen at a local level, but guided by the State with consistent policies
- OPRD permitting decisions – made based on gut instincts, not any particular science; doing the best they can but may be setting themselves up for potential lawsuits.
 - Currently have a small buffer between home and beach – OPRD has been using a general criterion of about 30 feet before allowing riprap to go in where eligible, but now only have a narrow buffer which may exacerbate the hazard

Changes/additions to policy and management:

- Exposed BPS's shall be removed if on non-eligible Goal 18 properties (meaning those built pre-emptively)
- Improved policies for setbacks and more restrictive development requirements, especially on ineligible Goal 18 properties and/or eligible properties that are not yet armored
- Stronger mechanisms for alternatives to riprap in BPS permitting requirements
- Requiring landowners whose BPS block beach access (north/south) to provide access up and around the structure
- Adopting many of the ideas/actions from the Neskowin Erosion Adaption Plan statewide or in other local jurisdictions:
 - Adopting DOGAMI's Hazard zones
 - Geologic engineering report
 - Making house/structures moveable in hazard zones (either vertically or horizontally)
 - Try to minimize risk but reducing vulnerability – lower density of development in the hazard zone.
- Softening of development practices – considering terrestrial erosion and how it contributes to shoreline erosion (meaning erosion caused by development, like runoff from road, pipes, etc)
- Proactive assistance (from State) to most vulnerable communities to develop options and solutions to address coastal hazards
- Moveable foundations or houses – requiring wash away walls on basement/ground floor.
 - Learning from development in hurricane areas
 - Planning for long term chronic hazards but also short term catastrophic events (when a mass wasting of a bluff occurs and feet are lost in a day)
 - Thinking about how development and infrastructure will be dealt with after a catastrophic event – any development on the coast is a potential hazard.
- Jurisdiction issues between OPRD and DSL around estuaries and creeks, especially in areas where it switches back and forth - A strong case should be made to go back and re-evaluate the rules surrounding areas where you have small creeks and streams that come out onto the coast and in the classification of estuaries.
- Notify landowners when land is partitioned or subdivided that their eligibility status may/will change
- Hazard disclosure statement – property owners should sign with their deed acknowledging that they aren't eligible for BPS so they can't claim they didn't know later.
- Not allowing landowners to build a home on their land if their new home will only be safe after a riprap is placed in front of the home. No artificial creation of a safe building site.
- Creating a local taxing district to help communities pay for certain tough solutions – like cost of repairing riprap to ensure its continuous; buying land to conserve for natural beach access; or buying property for oceanfront homeowners to move to eventually.
- Allowing riprap to certain sections of Highway 101 – important to balance the intentions of the goals with pragmatic solutions. Flexibility in the goal exception process for things that don't fit or don't make sense for goal application.

- Important to revisit the Goals to ensure they are working in practice and adaptive enough for things that come up that weren't thought about originally. There is room for some creative thinking on Goal 18. Littoral cell comprehensive planning might be an option – it's worth looking into; maybe with a focus group of policy thinkers to sort out what that may look like.
- Process for thinking about armoring in context of comprehensive planning
- Place hazard planning in the context of tsunami resilience planning since they are complementary and many communities are starting to plan for earthquakes and tsunamis more
 - Be ready to take advantage of opportunities (funding or otherwise) to leverage resources for resilience planning

Reality of changing existing policy to be more or less restrictive:

- It would be difficult in the current political climate to look at more restrictive and/or less policies in eligible Goal 18 areas. In ineligible areas it may be more acceptable for more restrictive policies or rules.
- Some local jurisdictions may have the desire to make new policies a priority to deal with shoreline erosion; however, only likely to happen with additional funds and/or staff.
- Critical to have local community support for any changes in policy, especially at local level.
- Resistance will likely be from developers wishing to be able to develop property however they want regardless of public safety.

Expected beach changes from climate change:

- Sea level rise will become a compounding issue in terms of coastal erosion as it accelerates, especially in Tillamook County and Lincoln County.
- We will likely see an increase in the requests for structures, more failures to bluffs and likely more homes going in to the ocean. There is less pressure on the southern Oregon coast, as long as development and populations continue to be low there.
- Big winter storms will continue in to the future. The 98/99 winter storm season with several really large storms in quick succession will happen again
- Property owners and communities will continue to armor the developed areas of the coast. Repairs will continue, increase and continually expand the footprint of the original riprap structures.
- Beaches will narrow; north /south public beach access will be impeded. New beaches will be formed in and around sand spits and inside of coastal bays. Coastal bluff backed beaches will be reduced in beach width with less shoreline access and recreational use.
- Climate change is still not fully accepted or understood in many small communities along the coast. Policies may need to be amended in the future to accommodate climate change issues.

Feasibility of re-alignment (moving of oceanfront properties) as an option:

- Yes, in the long term, but we haven't hit the tipping point yet. Will likely become more feasible as individual homeowners suffer the costs of repetitive BPS repair costs and the state has to come up with options for dealing with these issues.
- Great idea in theory but no money to do it. Taxpayers statewide are likely not going to support bailing out homeowners who decided to build in hazardous areas along the oceanfront.
- It's a matter of opinions of those who live in coastal communities and those from the outside who have second homes or development interests here: for the people who live and work here, they are most likely on the side of conserving coastal habitats and the public beach; while the development interests want to develop no matter what the costs.
- Retreat of coastal communities is inevitable if sea level rise predictions are true. There will be a time when BPS's will be fortified and the costs will be eventually be too much to bear for oceanfront property owners. Structures will fail and the shoreline will migrate inland affecting the next row/areas of homes and community infrastructure.
- It's going to be an interesting issue for a lot of coastal communities, because at some point, insurance companies are not going to want to insure them. At any rate, we're not there yet but the day is approaching.

Additional thoughts/ideas (potential end-products of fellowship):

- Would be helpful if State could produce literature on riprap information for the public that could be distributed to coastal communities and city halls.
- Have someone who could be a liaison for the OPRD BPS permit Staffer who could do spot assessments for property owners when erosion issues come up to decide whether action is likely needed or not (maybe someone from DOGAMI)
- Policy recommendations supported by research on armoring and some analysis of stakeholder and community interest
 - But to change things at the end of the day, we need legislative statutes. Scientifically-backed, stakeholder-driven, legislatively-mandated principles are needed here.
- Questions to be answered: How much coastal area is hardened with BPS and where is it located. What amount of BPS material has been placed and how much beach area has been covered up. How much potential sediment (estimated) has been locked from BPS hardening. Where are opportunities for increased protection from shoreline hardening?